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New York, New York 10029

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Accumulating evidence indicates that the "biobehavioral model" of health and disease may have considerable relevance for cancer generally, and breast cancer in particular. Broadly stated, this model proposes that what people think and feel affects the state of their health in two basic ways: by affecting their behavioral choices (e.g., smoking) and by affecting biological processes (e.g., cortisol levels) that affect risk and response to disease. Given the complexity of the interactions postulated by the biobehavioral model, to fully explore its implications for breast cancer it will be important to increase the number of researchers with the broad-based training that allows them to conduct truly interdisciplinary research addressing issues that transcend traditional disciplinary boundaries. Our ongoing Postdoctoral Training Program in Biobehavioral Breast Cancer Research is designed to provide trainees with advanced degrees in relevant areas (e.g., epidemiology, medicine, psychology, public health) with the necessary intellectual background needed to "speak the language" of the multiple relevant disciplines and with the "hands-on" experience under the tutelage of experienced mentors necessary to do interdisciplinary research and become independent investigators.

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## **5. INTRODUCTION:**

Accumulating evidence indicates that the "biobehavioral model" of health and disease may have considerable relevance for cancer generally, and breast cancer in particular. Broadly stated, this model proposes that what people think and feel affects the state of their health in two basic ways: by affecting their behavioral choices (e.g., smoking) and by affecting biological processes (e.g., cortisol levels) that affect risk and response to disease. Given the complexity of the interactions postulated by the biobehavioral model, to fully explore its implications for breast cancer it will be important to increase the number of researchers with the broad-based training that allows them to conduct truly interdisciplinary research addressing issues that transcend traditional disciplinary boundaries. Our ongoing Postdoctoral Training Program in Biobehavioral Breast Cancer Research is designed to provide trainees with advanced degrees in relevant areas (e.g., epidemiology, medicine, psychology, public health) with the necessary intellectual background needed to "speak the language" of the multiple relevant disciplines and with the "hands-on" experience under the tutelage of experienced mentors necessary to do interdisciplinary research and become independent investigators.

## **6. BODY:**

During the past year of this four year funded program of postdoctoral training, our primary focus has been the continued improvement of all aspects of the training program, Task 1 (a-k):

a) Consistent with our proposed developmental plan, we continue to conduct a nation-wide search for applicants for the postdoctoral positions offered. We continue to receive large numbers of applications from strong candidates around the country.

b) After an extensive evaluation process, including in person interviews with the strongest applicants, we have made offers to outstanding candidates, and have filled the four funded positions.

c) We have initiated and scheduled a series of "Core Course" lectures presented by members of the faculty of the Mount Sinai School of Medicine, supplemented by outside speakers with particular expertise on relevant topics. For example, internal speakers have included Dr. George Raptis of the Department of Medicine, who provided an integrated series of three lectures entitled: "An introduction to the pathobiology of breast cancer;" "The clinical management of early stage breast cancer;" and, "The treatment of metastatic breast cancer." A recent outside speaker was Dr. Gary Winkel of the Graduate Center City University of New York, who gave a mini course introducing advanced statistical analysis with SAS.

d) In addition we have supported a series of research seminars by Mount Sinai faculty and outside speakers to provide Trainees with exposure to recent developments in Biobehavioral Medicine, as well as related disciplines. For example, a recent outside speaker was Dr. Mark Litt of the University of Connecticut who presented his recent work on "Situational antecedents to smoking and drinking in alcoholic smokers: Analysis of experience sampling data."

e) As indicated above, both the Core Course Curriculum and Seminar Series have been running over the past year.

f) We continue our emphasis hands-on portion of the training program through the active mentoring of trainees by federally-funded faculty members.



g) The Luncheon Lecture series (sometimes rescheduled as the "Bagel Breakfast" meeting), covering recent journal articles, work in progress by local investigators, and career development considerations by outside speakers has been scheduled and run.

h) Guidance in the development of independent research projects has been provided by the mentors for each Trainee, as well as by feedback from other members of the faculty made more informally as part of the Luncheon Lecture series.

i) Oversight for each Trainee's independent project is being provided by their Mentor and more informally by the rest of the faculty at Work-in-Progress (WIP) presentations as part of the Luncheon Lecture series.

j) A formal evaluation of Trainees and the Program was conducted at the end of their third month in the program. A year-end evaluation is conducted around the time each Trainee completes their first year of the Program.

k) In the first year of each Trainee's participation in the program, the focus has been the preparation of research reports from previous relevant research they may have conducted before joining the program, the preparation of research reports from the data collected from projects previously collected by their Mentors, and the preparation of initial reports concerning data which they collected during their first year of the Program. The development of Trainee's skills in grant writing has been fostered by one-on-one tutorials about the process as their Mentors have written and submitted grants, as well as by participation in our "in-house" grant review meetings in which faculty present their preliminary drafts of applications.

## **7. KEY RESEARCH ACCOMPLISHMENTS:**

### **1) Key research accomplishments**

Conducted training program for 4 Postdoctoral Trainees

Recruited trainee applications

Evaluated potential trainees

Developed and scheduled Core Curriculum

Scheduled Seminar Series

Ran Core Curriculum and Seminar Series

Established "hands-on" research experience for each Trainee

Scheduled and ran Luncheon Lecture / Bagel Breakfast series

Guided development of independent research projects for each Trainee

Provided oversight for each Trainee's independent project

Conducted formal evaluations of Trainee and Program

Facilitated preparation of research reports and grant applications

## **8. REPORTABLE OUTCOMES:**

These are grouped alphabetically by Trainee below:

**DR. JULIE BRITTON:**

Britton JA, Westhoff CL, Howe G, Gammon MD. The relation between lactose and benign ovarian tumors in a case-control study (Poster abstract). American Journal of Epidemiology 1999;149:S6.

Stellman SD, Djordjevic MV, Britton JA, Muscat JE, Citron ML, Kemeny M, Busch E. Breast cancer risk in relation to adipose concentrations of organochlorine pesticides and polychlorinated biphenyls in Long Island, New York. Cancer Epidemiology, Biomarkers & Prevention 2000; 9:1241-1249.

Westoff C, Britton JA, Gammon MD, Wright T, Kesley J. (2000). Oral contraceptives and benign ovarian tumors. American Journal of Epidemiology 152(3): 242-246.

Britton JA, Westoff C, Howe G, Gammon MD. Diet and benign ovarian tumors (2000). Cancer Causes and Control 11(5):389-401.

Stellman SD, Djordjevic MV, Britton JA, Muscat JE, Citron ML, Kemeny M, Busch E. (2000). Breast cancer risk in relation to adipose concentrations of organochloride pesticides and polychlorinated biphenyls in Long Island, New York. Cancer Epidemiology, Biomarkers & Prevention 9:1241-1249.

Britton JA, Westhoff C, Howe GR, Gammon MD. (2000). Lactose and benign ovarian tumors in a case-control study. British Journal of Cancer 83(11):1552-1555.

Gammon MD, Neugut AI, Santella RM, Teitelbaum SL, Britton JA, Terry MB, Eng SM, Wolff MS, Stellman SD, Kabat GC, Levin B, Bradlow HL, Hatch M, Beyea J, Camann D, Trent M, Senie RT, Garbowski GC, Maffeo C, Montalvan P, Berkowitz GS, Kemeny M, Citron M, Schnabel F, Schuss A, Hajdu S, Vinciguerra V, Collman GW, Oubram GI. The Long Island Breast Cancer Study Project: Description of a multi-institutional collaboration to identify environmental risk factors for breast cancer (accepted, Breast Cancer Research and Treatment).

Britton JA, Gammon MD, Kelsey JL, Brogan DJ, Coates RJ, Schoenberg JB, Potischman N, Swanson CA, Stanford JL, Brinton LA. (2001) Characteristics associated with recent recreational exercise among women 20 to 44 years of age. Women & Health 31(2/3):81-96.

Wolff MS, Berkowitz GS, Lapinski R, Britton JA, Forman J, Hochman S, Kabat GC, Godbold J, Larson S. (submitted and under revision) Ethnic differences in onset of puberty and the influence of diet. American Journal of Clinical Nutrition.

Gammon MD, Santella RM, Neugut AI, Eng SM, Teitelbaum SL, Paykin A, Levin B, Terry MB, Young T, Wang Q, Britton JA, Wolff MS, Stellman SD, Hatch M, Kabat GC, Senie R, Garbowski G, Maffeo C, Montalvan P, Berkowitz GS, Kemeny M, Citron M, Schnabel F, Schuss A, Hajdu S, Vinciguerra V. (submitted). PAH-DNA adducts and the risk of breast cancer among women on Long Island.

Britton JA, Kushi L, Morabi A, Bernstein J, Shore R, Geringer W, Rohan T. (submitted). The development of a questionnaire to assess past year physical activity in a multi-ethnic/racial urban population.

Britton JA, Gammon MD, Schoenberg JB, et al. Risk of breast cancer classified by joint steroid receptor status in relation to established and putative hormone-related characteristics among women 20 to 54 years (in preparation).

Britton JA, Gammon MD, Kelsey JL, Brogan DJ, Coates RJ, Schoenberg JB, Potischman N, Swanson CA, Stanford, JL, Brinton LA. Characteristics associated with recent recreational exercise among women 20 to 44 years of age. Women & Health 2001;31(2/3):81-96.

Britton JA, Gammon MD, Schoenberg JB, Stanford JL, Coates RJ, Swanson CA, Potischman N, Malone K, Brogan DJ, Daling J, Brinton LA. (in press). Risk of breast cancer classified by joint estrogen receptor and progesterone receptor status among women 20 to 44 years of age. American Journal of Epidemiology

Gammon MD, Wolff MS, Neugut AI, Eng SM, Teitelbaum SL, Britton JA, Terry MB, Levin B, Stellman SD, Kabat GC, Hatch M, Senie R, Berkowitz GS, Bradlow, HL, Garbowski G, Maffeo C, Montalvan P, Kemeny M, Citron M, Schnabel F, Schuss A, Hajdu S, Vinciguerra V Santella RM,. (submitted). Organochlorine compounds and the risk of breast cancer among women on Long Island, New York: The Long Island Breast Cancer Study Project .

Britton JA, Wolff MS, Lapinski R, Forman J, Hochman S, Kabat GC, Godbold J, Larson S, Berkowitz GX. (submitted). Characteristics of pubertal development in a multi-racial/ethnic population of nine-year old girls.

#### Abstracts and Letters:

Stellman SD, Djordjevic MV, Britton JA, Thompson S, Gong L, Muscat JE, Citron ML, Kemeny M, Busch E. Breast cancer risk among women in Long Island, New York, in relation to adipose levels of organochlorine pesticides and polychlorinated biphenyls. AACR 1999.

Britton JA, Westhoff CL, Howe G, Gammon MD. The relation between lactose and benign ovarian tumors in a case-control study (Poster abstract). American Journal of Epidemiology 1999;149:S6.

Britton JA, Wolff MS, Berkowitz GS. Pubertal development in relation to recreational physical activity, sedentary activity and body size (Not accepted, poster abstract).

Britton JA, Gammon MD, Schoenberg JB, Stanford JL, Coates RJ, Swanson CA, Potischman N, Malone KE, Brogan DJ, Daling J, Brinton LA. Risk of Breast Cancer Classified by Joint Estrogen Receptor and Progesterone Receptor Status Among Women 20 to 44 Years of Age (Poster abstract accepted AACR 2002).

Teitelbaum SL, Britton JA, Gammon MD, Schoenberg JB, Brogan DJ, Daling J, Malone KE, Swanson CA, Brinton LA. Occupation and breast cancer in women under 45 years of age (Poster abstract accepted AACR 2002).

Britton JA, Wolff MS, Lapinski R, Forman J, Hochman S, Kabat GC, Godbold J, Larson S, Berkowitz GX. Characteristics of pubertal development in a multi-racial/ethnic population of nine-year old girls. (accepted for presentation, SER 2002).

#### Non-Experimental Articles:

Wolff MS, Britton JA, Wilson VP. (in press) Environmental Risk Factors for Breast Cancer Among African-American Women. Cancer

#### Invited Talks:

"Physical activity and breast cancer" October 1, 1999, The Maurer Foundation for Breast Health Education.

"Physical activity and breast cancer: Update" October 4, 2000, The Maurer Foundation for Breast Health Education.

### **Presentation & Journal Clubs:**

Characteristics associated with past year recreational exercise among women 20 to 45 years of age (Presentation, April 1999; Derald H. Ruttenberg Cancer Center – Cancer Prevention and Control, Mount Sinai School of Medicine, New York, NY)

Physical activity and breast cancer (Environmental Epidemiology Seminar, September 1999; Department of Community and Preventive Medicine, Mount Sinai School of Medicine, New York, NY)

Pubertal development in relation to recreational physical activity, sedentary activity and body size (Work-in-progress, DATE; Derald H. Ruttenberg Cancer Center – Cancer Prevention and Control, Mount Sinai School of Medicine, New York, NY)

Wyshak G, and Frisch RE. Breast cancer among former college athletes compared to non-athletes: a 15-year follow up 2000;82(3):726-730 (Journal club, March 9, 2000; Derald H. Ruttenberg Cancer Center – Cancer Prevention and Control, Mount Sinai School of Medicine, New York, NY)

Michels KB, Greenland S, Rosner BA. Does body mass index adequately capture the relation of body composition and body size to health outcomes? American Journal of Epidemiology 1998;147:167-72. (Biostatistics journal club, August 8, 2000; Department of Community Medicine, Mount Sinai School of Medicine, New York, NY)

Smith-Warner SA, Spiegelman D, Yaun S, Adami H, Beeson WL, van den Brandt PA, Folsom AR, Fraser GE, Freudenheim JL, Goldbohm RA, Graham S, Miller AB, Potter JD, Rohan TE, Speizer FE, Toniolo P, Willett WC, Wolk A, Zeleniuch-Jacquotte A, Hunter DT. Intake of fruits and vegetables and risk of breast cancer: a pooled analysis of cohort studies. JAMA 2001;285(6):769-776 (Environmental Journal club, April 17, 2001; Department of Community Medicine, Mount Sinai School of Medicine, New York, NY)

Schaffer DM, Velie EM, Shaw GM, Todoroff KP. Energy and nutrient intakes and health practices of Latinas and white non-Latinas in the 3 months before pregnancy. (Environmental Journal club, January 15, 2002; Department of Community Medicine, Mount Sinai School of Medicine, New York, NY)

Schildkraut JM, Calingaert B, Marchbanks PA, Moorman PG, Rodriguez GC. Impact of progestin and estrogen potency in oral contraceptives on ovarian cancer risk. (Journal club, January 25, 2002; Derald H. Ruttenberg Cancer Center – Cancer Prevention and Control, Mount Sinai School of Medicine, New York, NY)

### **DR. DAVID DANIEL:**

David, D. (2001). Unconscious Information processing and mental contamination; Implication for cognitive behavioral psychotherapy. Paper presented to the Albert Ellis Institute, NY, USA (E).

David, D. (2001). Correlates of hypnotic susceptibility; The case of cognitive inhibition. Society for Clinical and Experimental Hypnosis, SA, USA (E).

David, D., King, B. (2001). Cognitive inhibition and hypnotizability. Cognition Brain and Behavior (Cognition, Creier, Comportament), 1-2, 197-213 (English).

David, D., & McMahon, J. (2001). Clinical strategies in cognitive behavioral therapy; A case analysis. Romanian Journal of Cognitive and Behavioral Psychotherapy, 1, 71-86 (English).

David, D., King, B., Borchardt, J. (2001). Is cognitive inhibition correlated with hypnotizability?. International Journal of Clinical and Experimental Hypnosis, 49, 30-37.

David, D., & Brown, R. (in press). Suggestibility and negative priming: Two replications studies. International Journal of Clinical and Experimental Hypnosis.

David, D., Montgomery, G., & Holdevici, I. (in press). Romanian norms for the Harvard group Scale of Hypnotic Susceptibility, Form A. International Journal of Clinical and Experimental Hypnosis.

Montgomery, G. H., David, D., Goldfarb, A. B., Weltz, C. R., Birk, J. S., & Bovbjerg, D. (2002). The influence of you and your surgeon on distress: the case of diagnostic information and optimism/pessimism. American Cancer Society, USA (E).

Montgomery, G.H., David, D., Winkel, G., Silverstein, J. H., & Bovbjerg, D. H. (2002) The effectiveness of adjunctive hypnosis with surgical patients: A meta-analysis. Anesthesia & Analgesia 94:1639-1645.

David, D., Moore, M., & Domuta, A. (in press). Romanian psychology on the international psychological scene: A preliminary critical and empirical approach. European Psychologist.

#### DR. JENNIFER EGERT:

Keefe FJ, Lefebvre J, Egert JR, Affleck G, Sullivan MJ, Caldwell DS (2000). Catastrophizing Mediates the Relationship of Gender to Pain and Pain-Related Outcomes in Osteoarthritis Patients. Pain 87:325-334.

Keefe FJ, Affleck G, Lefebvre J, Underwood L, Caldwell DS, Drew J, Egert JR, Gibson J, Pargament K (2001). Coping with Arthritis Pain: The Role of Daily Spirituality and Daily Religious and Spiritual Coping. Journal of Pain 2(2):101-110.

Egert JR, Keefe FJ, Winer E, Rimer B (submitted). Coping and Social Support as Predictors of Positive Dimensions of Psychological Well-Being Among Women who Completed Treatment for Early Stage Breast Cancer.

Egert JR, Keefe FJ, Winer E, Rimer B. (submitted) Re-defining a "Good adjustment" to cancer: psychological well-being, coping and social support following breast cancer treatment.

Egert JR, Winer E, Smith MY, Rimer B, Winkel G, Keefe FJ. (submitted). Psychological well-being, distress and quality of life following treatment for early stage breast cancer.

Smith MY, Egert JR, Winkel G, Jacobson J. (submitted). Post-traumatic stress disorder and pain symptoms in persons with HIV/AIDS: A prospective study.

Egert JR, Keefe FJ, Winer E, DuHamel K. (2001). Purpose in life, social support and distress among early stage breast cancer survivors. Paper presentation at the 2001 Conference of the Society of Behavioral Medicine in Seattle, Washington.

Egert JR, DuHamel K, Carapetyan KJ, Smith M. (2001). Resiliency and Adjustment to Living with Breast Cancer. Poster presentation at the 2001 Conference of the Society of Behavioral Medicine in Seattle, Washington.

Smith M, Egert JR, Jacobson J. (2001). Post-traumatic stress disorder in low-income persons with HIV/AIDS (PWHAs) experiencing persistent pain. Citation paper presented at the 2001 Conference of the Society of Behavioral Medicine in Seattle, Washington.

**DR. ANNE FATONE:**

Fatone, A., Jandorf, L., Modibo Baker, J., Brenner, B., Butts, G., Cornbill, R., Itzkowitz, S.H., Levin, M., Rothenberg, A., Sacks, H., Weeks, M., Redd, W.H. (2002, in preparation). East Harlem Partnership for Cancer Awareness (EHPCA): collaborative cancer screening and prevention research in an urban minority community.

**DR. JOSEPHINE GUEVARRA:**

Guevarra JS, Bovbjerg DH, Valdimarsdottir, HB (2000). African-American acculturation and breast self-examination frequency. Poster presented to the American Psychosomatic Society 58<sup>th</sup> Annual Scientific Meeting, March 2000, held in Savannah, GA.

Guevarra JS, Bovbjerg DH, Valdimarsdottir HB. (2000). Role of African-American acculturation in breast self-examination frequency. Poster presented at the 7th Biennial Symposium on Minorities, the Medical Underserved and Cancer Conference held in Washington, DC.

Bovbjerg DH, Valdimarsdottir HB, Guevarra JS, Godfrey D, Freeman HP (2000). Psychobiological stress of familial breast cancer risk among African-American women. Poster accepted to the 2000 Society of Behavioral Medicine. Conference held March 2000, in San Diego, CA.

Guevarra JS, Tang TS, Valdimarsdottir HB, Freeman DH (submitted). Further psychometric validation of the African-American Acculturation scale and its relationship to breast self-examination frequency.

Thompson HS, Valdimarsdottir HB, Guevarra JS, Duteau-Buck C, Richmond-Avellaneda C, Amarel D, Godfrey D, Scheuer L, Offit K (submitted). Psychosocial barriers to genetic counseling and testing in African-American women.

Valdimarsdottir, H, Duteau-Buck C, H, Guevarra J, Amarel D, Richmond-Avellaneda C, Godfrey, D, Scheuer L, Offit K. (2000). Psychosocial Predictors of Genetic Testing Decision Among African American women. Presented at the Era of Hope DOD BCRP, Atlanta, Georgia.

Guevarra, J.S., Tang, T., Bovbjerg, D.H., Valdimarsdottir, H.B., Godfrey, D., Freeman, H.P. (submitted). Effects of African American Acculturation on breast self-examination frequency.

**DR. YOUNGMEE KIM:**

Kim Y, Morrow G. (submitted). The effect of changes in family environment on the side effects of chemotherapy: Age and gender differences. Psycho-Oncology.

Kim Y, Seidlitz L, Ro Y, Evinger J, Duberstein PR. (submitted). Spirituality and affect: A lifecourse perspective. Journal for Scientific Studies of Religion.

Sheldon, K., Elliot, A., Kim, Y., & Kasser, T. (2001). What's satisfying about satisfying events? Testing ten candidate psychological needs. Journal of Personality and Social Psychology, 80, 325-339.

Elliot, A. J., Chirkov, V. I., Kim, Y., & Sheldon, K. M. (2001). A cross-cultural analysis of avoidance (relative to approach) personal goals. Psychological Science, 12, 505-510.

Kim, Y., Deci, E. L., & Zuckerman, M. (in press). The self-regulation of withholding negative emotions: Development of a questionnaire. Educational and Psychological Measurement.

Kim, Y., & Seidlitz, L. (in press). Spirituality moderates the effect of stress. Personality and Individual Differences.

Kim, Y., Roscoe, J., & Morrow, G. R. (in press). The effects of information and negative affect on cancer treatment-related side effects. Supportive Care in Cancer.

Kim, Y., Kasser, T., & Lee, H. (in press). Self-concept, aspiration, and well-being in Korea and the United States. Journal of Social Psychology.

Kim, Y., Morrow, G. R., Roscoe, J. A., Hickock, J. (2001, March). Inhibiting development of anticipatory nausea: The effects of family support, patient's anxiety, and post-treatment nausea. Paper presented at the Society of Behavioral Medicine, Seattle, WA. S123.

Kim, Y., & Duberstein, P. R. (2001, March). Depression in spouses of people with lung cancer: Personality, social support and caregiving burden. Paper presented at the Society of Behavioral Medicine, Seattle, WA. S122.

Kim, Y., Valdimarsdottir, H. B., & Bovbjerg, D. H. (2002, March). Coping strategies as moderators of cancer-specific distress among healthy women with family histories of breast cancer. Paper presented at the American Psychosomatic Society, Barcelona, Spain. Psychosomatic Medicine, 64, 106.

Kim, Y., Montgomery, G. H., Valdimarsdottir, H. B., & Bovbjerg, D. H. (2002, March). Familial risk of cancer and distress: Role of neuroticism and extraversion. Paper presented at the American Psychosomatic Society, Barcelona, Spain. Psychosomatic Medicine, 64, 140.

Kim, Y., Karen E. H., & Morrow, G. R. (2002, March). The effects of changes in family conflict on changes in post-treatment nausea: Age differences. Paper presented at the American Psychosomatic Society, Barcelona, Spain. Psychosomatic Medicine, 64, 140.

Kim, Y., Valdimarsdottir, H. B., & Bovbjerg, D. H. (2002, April). Family Histories of Breast Cancer, Health Locus of Control, and Coping. Paper presented at the Society of Behavioral Medicine, Washington D.C. Annals of Behavioral Medicine 2002 Supplement, 24:S167.

Kim, Y., Duberstein, P. R., Sörensen, S. & Larson, M. R. (submitted). Depression in spouses of people with lung cancer: Effects of personality, social support, and caregiving burden.

Kim, Y., & Morrow, G. R. (submitted). The effects of family support, anxiety, and post-treatment nausea on the development of anticipatory nausea: A latent growth structural model.

Kim, Y., Valdimarsdottir, H. B., & Bovbjerg, D. H. (submitted). The moderating effects of coping on the psychological impact of having a family history of breast cancer.

Sheldon, K. M., Elliot, A. J., Ryan, R. M., Chirkov, V., Kim, Y., Wu, C. Demir M., & Sun Z. (submitted). Autonomy and collectivism: Complementary, not conflicting.

Kim, Y. (submitted). Specialized and fragmented cognitive concept on the self and romantic relationships.

Kim, Y. Emotional and cognitive consequences of adult attachment: The mediating effect of the self.

Kim, Y., Sahler, O.J., Messauer, L., & Vattimo, C. (submitted). Parental adjustment in childhood cancer: Marital and occupational issues.

#### Manuscripts in Revision:

Kim, Y., & Morrow, G. (submitted). The effect of changes in family environment on the side effects of chemotherapy: Age and gender differences. Psycho-Oncology.

Kim, Y., & Morrow, G. R. (submitted). The moderating effect of family environment on chemotherapy-induced nausea.

Kim, Y., Seidlitz, L, Ro, Y., Evinger, J. & Duberstein, P. R. (submitted). Spirituality and Affect.

**Presentations:**

Kim, Y. (2001, July). Contribution of Psychology in Cancer Research. Invited talk at the Annual Meeting of Korean Clinical Psychology Association, Danyang, Korea.

Kim, Y., & Bovbjerg, D. H. (2002, July). Psychological Consequences of Cancer Caregiving. Paper presented at International Society for the Study of Personal Relationships, Halifax, Canada.

**DR. NAA OYO KWATE:**

Kwate, N.O. (2001). Intelligence or Misorientation?: Eurocentrism in the WISC-III. The Journal of Black Psychology, 27(2), 221-238.

Guevarra, J.S., Tang, T.S., Valdimarsdottir, H.B., Freeman, H.P., Kwate, N.O., & Bovbjerg, D.H. (submitted). The African-American Acculturation Scale and its Relationship to Smoking and Breast Self-Examination Frequency.

Kwate, N.O. African-centered psychology as a heretical challenge to North American mental health.

**Book Chapters:**

Kwate, N.O. (in press). The Projection of Eurocentrism in Projective Testing. African-centered Psychology. North Carolina Press.

**Presentations:**

"Gastroafricenteritis: Nutritional Misorientation and African-Centered Healing". 32nd Annual Convention of the Association of Black Psychologists, Accra, Ghana - August 5, 2000.

Walton, K., Ryan, E., van Gorp, W.G., Ferrando, S., Rabkin, J., Kainen, E., Finkelberg White, S., & Kwate, N.O. "Clinical Markers of HIV Disease Progression and their Relationship to Psychomotor Functioning". 29th Annual Convention of the International Neuropsychological Society, Chicago, IL - February 15, 2001.

Kwate, N.O., Valdimarsdottir, H.B., Guevarra, J.S., & Bovbjerg, D.H. "Racism Affects African American Women's Health". The 2002 Annual Society of Behavioral Medicine Meeting, Washington, DC.



**DR. TRICIA TANG:**

Tang TS, Solomon LJ, Matthews AK. Barriers to colorectal cancer screening among Chinese women 60 and older. Poster presented at the Association of Advancement in Behavior Therapy Conference. Toronto, Canada, November 12, 1999.

Tang TS, Solomon LJ, McCracken LM. Barriers to mammography, clinical breast examination and breast self-examination among Chinese women 60 and older. Poster presented at the Association of Advancement in Behavior Therapy Conference, Toronto, Canada, November 12, 1999.

Guevarra JS, Tang TS, Valdimarsdottir HB, Freeman HP, Bovbjerg DH (submitted). Further psychometric validation of the African-American Acculturation Scale and its relationship to breast self-examination frequency.

Tang TS, Solomon LJ, McCracken LM. Barriers to breast cancer screening among older Chinese women. Poster presented at the 7th biennial Symposium on Minorities, the Medical Underserved and Cancer Conference, Washington, DC, February 12, 2000.

Tang TS, Solomon LJ, McCracken LM. Race and cancer screening: Is there a mediating relationship? Poster presented at the 2000 Society of Behavioral Medicine Conference, Nashville TN, April 6, 2000.

McCracken LM, Matthews AK, Tang TS, Cuba SL (submitted). Sociocultural influences on the experience of chronic pain: Do African-American patients adjust differently compared to European Americans?

**9. CONCLUSIONS: N/A**

## Short Communication

# Lactose and benign ovarian tumours in a case-control study

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**Summary** We investigated the relation between benign ovarian tumours and lactose among 746 case women identified at seven New York metropolitan hospitals and 404 community controls, age and hospital frequency matched to the expected case distribution. No increase in risk was found for lactose (highest quartile versus lowest: adjusted odds ratio = 0.82 (95% CI 0.57–1.20) or for any other lactose foods. © 2000 Cancer Research Campaign <http://www.bjcancer.com>

**Keywords:** case-control studies; diet; lactose; nutrition; ovarian neoplasms; risk factors

Galactose levels are determined by dietary sources (primarily lactose) and metabolism-related factors. The theory linking galactose to ovarian cancer aetiology originates from galactosaemia, which is characterized by the absence of transferase. Some galactosaemics experience ovarian failure or have elevated gonadotropins levels (Kaufman et al, 1981), which may increase ovarian cancer risk (Gardner, 1961; Cramer and Welch, 1983). An increased ovarian cancer risk has been reported with higher lactose intakes and with a higher lactose to transferase activity ratio (Cramer et al, 1989).

The surgical diagnosis of benign epithelial tumours declines at ages when epithelial ovarian cancer incidence increases, suggesting that a small proportion of BOTs may progress to their invasive malignant counterparts (Bennington et al, 1968). This is consistent with observations of benign neoplasia located adjacent to or within ovarian cancers (McKay, 1962; Puls et al, 1992), and of benign to malignant epithelium histologic transition in one-quarter of a sample of ovarian cancers (Puls et al, 1992). Thus, benign and malignant ovarian tumours may share a common aetiology, and if so, they afford an opportunity to investigate potential risk factors closer to the time of aetiological interest.

## MATERIALS AND METHODS

Methods of this study have been described in more detail elsewhere (Westhoff et al, 2000). In this study English-speaking women, aged 18 to 74, with a telephone, residing in the New York metropolitan area within 50 miles of a participating hospital, having an ovary and not having a malignant tumour were eligible. Institutional review boards approved the study protocols.

BOT cases were diagnosed in 1992 and 1993. A uniform pathology review determined eligibility and histologic classification (Russell and Bannatyne, 1989). Controls, frequency-matched to the expected case distribution by 10-year age group and hospital, were identified using Waksberg's random digit dialing (RDD) method (Waksberg, 1978; Hartge et al, 1984). Participation rates among the cases and controls were 80.7% ( $n = 746$ ) and 71.4% ( $n = 404$ ), respectively. RDD screener response rate was 84.9%.

A structured questionnaire was administered. A 127-item Willett food frequency questionnaire (FFQ) (Willett, 1990) about usual dietary intake during the 12 to 24 months before interview was self-completed by 90% ( $n = 673$ ) of the cases and 87% ( $n = 352$ ) of the controls (Britton et al, 2000). Primary lactose foods included skim or low-fat milk, whole milk, cream, sour cream, sherbet or ice milk, ice cream, yogurt, cottage or ricotta cheese, cream cheese, and other cheeses such as American or cheddar cheese.

Median lactose intakes were compared by the Wilcoxon test (Conover, 1980). Unconditional logistic regression produced adjusted odds ratios (ORs) and 95% confidence intervals (CIs) (Hosmer and Lemeshow, 1989). Controls were compared to all cases and to the more common histologic sub-types: endometriomas, serous adenomas and teratomas.

Lactose (grams per day) was considered as a continuous and categorical variable (classified into quartiles). The residual nutrient method was used for the latter (Willett et al, 1997). Foods were divided into three categories according to the control frequency distribution. In the models, categorical variables were represented as indicator variables and adjustment was made for age (<25/25–34/35–44/45–54/55–64/65+ years), hospital (seven categories), total energy (kilocalories per day), and body mass index (BMI: weight in kilograms/height in metres squared) for the year prior to interview. When dietary fat and non-dietary factors were considered as confounders, estimates were unaffected thus subsequent models omitted these factors. To assess trends, quartile levels or indicator variable scores were entered in models as ordinal variables.

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**Table 1** Odds ratios and 95% confidence intervals for benign ovarian tumours, according to lactose intake as categorized by quartiles, among 1015 women in the New York Metropolitan Area, 1992–1993

	Controls		Endometrioma <sup>b</sup>		Mucinous adenoma		Serous adenoma		Teratoma <sup>b</sup>		All cases <sup>b</sup>		
Exposure	(no.) <sup>a</sup>	(no.)	OR <sup>a,c</sup>	95% CI <sup>a</sup>	(no.)	OR <sup>c</sup>	95% CI	(no.)	OR <sup>c</sup>	95% CI	(no.)	OR <sup>c</sup>	95% CI
Quartiles of lactose intake (grams)													
Q1 (≤5.58)	86	72	1.00		15	1.00		51	1.00		38	1.00	
Q2 (5.59–10.42)	87	77	1.11	0.69–1.79	14	0.97	0.41–2.28	30	0.61	0.34–1.10	36	1.01	0.56–1.81
Q3 (10.43–17.11)	88	74	1.06	0.66–1.70	20	1.37	0.62–3.02	51	1.08	0.63–1.83	50	1.37	0.79–2.38
Q4 (>17.11)	86	57	0.77	0.48–1.26	11	0.75	0.31–1.79	40	0.78	0.45–1.35	41	1.05	0.61–1.83
P for trend			0.31			0.77			0.82			0.60	
												0.46	

<sup>a</sup>no., number of subjects; OR, Odds ratio; CI, Confidence interval. <sup>b</sup>One woman with a teratoma and one with an endometrioma with missing information on body mass index (weight in kilograms/height in metres squared) were excluded from the logistic models. <sup>c</sup>Adjusted for age, hospital, total caloric intake, and body mass index for the year prior to interview.

**Table 2** Odds ratios and 95% confidence intervals for benign ovarian tumours in relation to lactose-food items, among 1015 women in the New York Metropolitan Area, 1992–1993

Exposure	Controls		Endometrioma <sup>b</sup>		Serous adenoma		Teratoma <sup>b</sup>		All cases <sup>b</sup>	
	(no.) <sup>a</sup>	(no.)	OR <sup>a,c</sup>	95% CI <sup>a</sup>	(no.)	OR <sup>c</sup>	95% CI	(no.)	OR <sup>c</sup>	95% CI
Whole milk (8 oz or 236.8 ml) <sup>a</sup>										
Never or $< 1$ /month	191	168	1.00		115	1.00		112	1.00	
1/month– $\leq 1$ /week	75	58	0.81	0.54–1.24	20	0.51	0.29–0.91	23	0.48	0.28–0.83
2+/week	68	47	0.82	0.52–1.28	24	0.69	0.39–1.20	26	0.59	0.34–1.01
Not ascertained	13	7			13			4		
P for trend			0.29			0.07			0.01	
Skim/low-fat milk (8 oz or 236.8 ml)										
Never or $< 1$ /month	132	90	1.00		61	1.00		50	1.00	
1/month– $\leq 1$ /week	57	48	1.26	0.77–2.06	26	0.99	0.55–1.78	28	1.28	0.72–2.28
2+/week	152	137	1.25	0.86–1.81	79	1.13	0.74–1.75	84	1.43	0.92–2.22
Not ascertained	6	5			6			3		
P for trend			0.26			0.56			0.11	
Yogurt (1 c or 226.8 g) <sup>a</sup>										
Never or $< 1$ /month	116	94	1.00		51	1.00		60	1.00	
1/month– $\leq 1$ /week	126	120	1.15	0.79–1.70	64	1.25	0.77–2.01	60	0.89	0.56–1.39
2+/week	101	65	0.84	0.54–1.30	52	1.20	0.73–1.98	44	0.79	0.49–1.29
Not ascertained	4	1			5			1		
P for trend			0.52			0.48			0.35	

<sup>a</sup>no., number of subjects; OR, odds ratio; CI, confidence interval; ml, millilitres; g, grams; oz, ounces; c, cups. <sup>b</sup>One woman with a teratoma and one with an endometrioma with missing information on body mass index (weight in kilograms/height in metres squared) were excluded from the logistic models. <sup>c</sup>Adjusted for age, hospital, total caloric intake, and body mass index for the year prior to interview.

## RESULTS

After exclusion of 1% of cases and controls with extreme energy intake (Howe et al, 1990; Hunter et al, 1996) 668 case women and 347 control women remained. Women could have multiple tumours of differing histology as a result the cases were diagnosed with 717 BOTs: 172 serous, 60 mucinous, 280 endometrioid, and 8 Brenner tumours, as well as 165 teratomas and 32 fibroma-thecomas. All women (Westhoff et al, 2000) and those providing dietary information (Britton et al, 2000) had similar distributions of demographic and other characteristics. In general, controls were significantly more likely than cases to be parous and to have a non-private or no health care provider, a possible indicator of less diagnosis opportunity. Cases were non-significantly more likely to be white, never OC users and have larger BMI. The mean case age of 42.2 years (standard deviation (SD) = 11.9) was slightly older than the mean control age of 41.5 years (SD = 12.5) ( $P = 0.4$ ).

All cases combined and each histologic type, except endometriomas, had non-significantly higher median lactose intakes than controls (data not shown). There was no evidence of an association or a dose–response relation between lactose intake and BOTs or any of the histologic sub-types (Table 1). Continuous lactose measures yielded similar findings; the ORs and 95% CIs per 10 grams of lactose were 0.90 (0.76–1.06), 0.89 (0.65–1.21), 0.96 (0.80–1.16), 1.07 (0.89–1.27), and 0.97 (0.85–1.10), for endometriomas, mucinous adenomas, adenomas, teratomas, and all BOTs combined, respectively.

Only whole milk was associated with BOTs (Table 2). A significant inverse relation was observed for all BOTs combined and for teratoma tumours, while a borderline significant inverse association was noted for tumours. Though these tests are indicative of an inverse trend, the observed association for the middle category of whole milk intake was either the same as or stronger than that observed for the highest category of intake. There were no other statistically significant associations or dose–response

relations for BOTs combined or for the individual histologic subtypes and consumption of any other lactose foods (selected items shown in Table 2).

## DISCUSSION

In this study, whole milk was the only item significantly associated with BOTs for which estimates were below the null. Adjustment for total and types of dietary fat as well as lactose did not change the association. Thus, our results do not support an increased BOT risk in relation to the lactose or dietary fat component of dairy products. This agrees with our earlier finding of no relation between BOTs and saturated fat (Britton et al, 2000).

If BOTs share a common aetiology with, or are precursors of malignant tumours, then the suggestion that either lactose or high-fat dairy products (Mettlin and Piver, 1990) increase ovarian cancer risk is not supported by this study. Our null lactose findings are consistent with studies examining borderline (Risch et al, 1996) or malignant ovarian (Engle et al, 1991; Risch et al, 1994a; Herrinton et al, 1995; Mink et al, 1996; Webb et al, 1998) tumours, but contrast the findings of an elevated ovarian cancer risk in relation to lactose intake (Cramer et al, 1989) or in relation to the lactose to transferase ratio (Cramer et al, 1989). Lactose consumption relative to metabolic capability may be a more relevant measure of galactose exposure but information on transferase activity or lactose tolerance was not available. Finally, we found a reduced BOT risk associated with higher whole milk consumption. Studies of ovarian cancer risk and either whole milk (Cramer et al, 1984, 1989; Mettlin and Piver, 1990; Ursin et al, 1990; Risch et al, 1994a; Webb et al, 1998; Kushi et al, 1999) or dietary fat (Byers et al, 1983; Shu et al, 1989; Slattery et al, 1989; Tzonou et al, 1993; Rische et al, 1994b; Mink et al, 1996; Webb et al, 1998; Kushi et al, 1999) consumption have inconsistent findings, generally reporting no association or an elevated risk.

Participants in health-related studies might be more health conscious and therefore more likely to consume or report low-fat foods. This, coupled with the lower control response rate, could result in selection bias. Or, cases may be more motivated to provide truthful responses than controls, resulting in recall bias. These biases would result in an underestimation of low-fat, but an overestimation of high-fat, food associations. In light of the null findings, it is hard to conceive that these biases are selectively affecting low-fat food associations. Lactose findings should be unaffected because the lactose and fat content of foods are independent.

We assessed commonly eaten major and minor lactose sources enabling us to rank participants' lactose exposure. The foods assessed were similar to the short list of items examined in a study reporting a high correlation ( $r = 0.96$ ) between lactose estimated using 34 versus 7 lactose foods (Cooper et al, 1995). Among controls the expected ethnic/racial variation in lactose intake was observed (Scrimshaw and Murray, 1988). These findings, together with the similar mean lactose intakes for our white controls and those in another study (Cramer et al, 1989), lend credence to our lactose measure.

Overall the study's findings do not support an elevated BOT risk in relation to lactose and are consistent with the results of most of the ovarian cancer studies (Engle et al, 1991; Risch et al, 1994a, 1996; Herrinton et al, 1995; Mink et al, 1996; Webb et al, 1998). The failure to detect an association might reflect a lack of power particularly in the histologic sub-type analyses. Finally,

the reduction in BOT risk for greater whole milk intake could be a chance finding given the multiple comparisons made.

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## Diet and benign ovarian tumors (United States)

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**Key words:** case-control studies, diet, nutrition, ovarian neoplasms, risk factors.

### Abstract

**Objectives:** The relation between benign ovarian tumors (BOTs) and nutrients, primarily dietary fat, was examined using case-control data.

**Methods:** 746 cases were diagnosed from 1 January 1992 to 31 December 1993. The 404 age- and hospital frequency-matched community controls were identified by random digit dialing. Six hundred seventy-three cases and 351 controls provided dietary information.

**Results:** The risk of BOTs was elevated for the highest vs. lowest quartile of intake of total, vegetable, saturated, monounsaturated, and polyunsaturated fat. The corresponding age-, hospital-, total energy-, and body mass index-adjusted odds ratios (ORs) and 95% confidence intervals (CIs) are 1.3 (0.9–1.9), 1.7 (1.2–2.5), 1.2 (0.8–1.8), 1.3 (0.9–1.8), and 1.6 (1.1–2.3). After adjustment for polyunsaturated fat, the risk of BOTs only remained elevated for vegetable fat (highest vs. lowest quartile OR and 95% CI = 1.4 (0.8–2.3)). Elevated risks were observed for higher intakes of polyunsaturated fat with endometrioid, serous, and teratoma tumors. Higher intakes of vegetable fat, adjusted for polyunsaturated fat, increased the risk of endometrioid, mucinous, and serous tumors. Only the risk of serous BOTs was consistently lower for higher intakes of micronutrients, with the strongest reduction observed for sources of vitamin A. Estimates were not confounded by non-nutrient covariates.

**Conclusions:** Polyunsaturated and vegetable fat may increase the risk of BOTs, while vitamin A may lower the risk of serous BOTs; however, these findings and lack of associations for other nutrients should be replicated.

### Introduction

The estimates of annual occurrence of surgically diagnosed cases of benign ovarian tumors (BOTs) in the United States range from 36 to 51 per 100,000 women [1–3], with the only population-based study yielding an estimate of 49.5 per 100,000 women [3]. BOTs not only place a burden on the health care system [4], but a small percent of these tumors may progress to invasive ovarian neoplasms [5, 6]. Additionally, certain ovarian benign and malignant histologic tumors may share a common etiology. In particular, parity has been found to reduce the risk of both benign [7–10] and malignant [11] ovarian tumors. Furthermore, oral contraceptive (OC) use has also been associated with a lower risk of BOTs, but the association has not been as strong and as

consistent as it is for malignant ovarian tumors [2, 7–10, 12–14]. If BOTs progress or share a common etiology, they afford an opportunity to investigate potential risk factors for malignant neoplasms closer to the time of etiologic interest.

Though several ecological [15–22] and case-control studies [23–26] have indicated that ovarian cancer incidence and mortality may be related to dietary fat intake, the findings of a case-control study [27] and two prospective cohort studies [28, 29] do not corroborate such a relation. Among the supportive studies, saturated fats [24, 25, 27, 30], rather than monounsaturated or polyunsaturated fats [24, 25, 27], increase the risk of ovarian cancer. Similarly, animal, instead of vegetable, sources of fat have also been associated with an increased risk of ovarian cancer [26, 30]. For micronu-

trients the evidence for a reduction in ovarian cancer risk for higher intakes of vitamin A [23, 24, 26, 27, 29], retinol [23, 25, 26, 29, 31], carotene [23, 25, 26, 31], vitamin C [23, 24, 26, 27, 29], or fruits [26, 29, 31] is weak. In contrast, the results have more consistently shown a lower risk of ovarian cancer for higher intakes of beta-carotene [24, 25, 29, 32], vegetables [23, 26, 28, 29, 31, 32], and fiber [23–27]. Whether only one, or all, of these is associated with ovarian cancer is difficult to assess since intake of these items is highly correlated.

This case-control study provides the first opportunity to evaluate whether dietary fat intake increases the risk of all BOTs combined as well as of the histologic subtypes endometrioid, serous, teratoma, and mucinous. Furthermore, the hypothesis that micronutrient consumption might reduce the risk of BOTs and the histologic types will be explored.

## Materials and methods

### *Study population*

The methods of this case-control study, undertaken primarily to evaluate whether the use of OCs was associated with BOTs, have been previously described [33]. To be eligible for the study women had to be English-speaking, aged 18–74, reside in the New York Metropolitan area within 50 miles of a participating hospital, had to have a telephone, and had to have at least one ovary. All protocols were approved by the relevant institutional review boards. Cases were women diagnosed, between 1 January 1992 and 31 December 1993, with a benign ovarian tumor, including mature teratoma, endometrioid, serous, mucinous, Brenner or fibroma-thecoma. Women with a coexisting malignant neoplasm were excluded. Using histopathology criteria recommended by the World Health Organization and the International Federation of Gynecology and Obstetrics, the study pathologist determined final eligibility and histologic types [34]. In general, there was strong agreement between the original diagnosing and study pathologists' classifications, as indicated by high kappa values: mature teratoma (0.99), endometrioid (0.93), serous (0.70), mucinous (0.94), Brenner (0.94), and fibroma-thecoma (0.96). Since a woman could have multiple benign tumors, each type was classified.

Controls were identified using a modified Waksberg's method of random digit dialing [35, 36]. The area code and telephone prefixes of all women admitted for gynecological care at the participating hospitals provided the basis for sampling. Controls were frequency-matched to the distribution of benign ovarian tumor

cases by 10-year age group and hospital. Since subtypes of benign tumors have different age distributions, controls were matched so that for each 10-year age category there were at least as many controls as there were cases for the largest subtype of cases. Finally, women undergoing treatment for cancer were ineligible to be controls.

Of the 924 women identified with confirmed BOTs, 746 (80.7%) participated in the main study interview. The reasons for non-participation were 89 (9.6%) subject refusals, 43 (4.7%) doctor refusals, and 46 (5.0%) subjects who were not traced or interviewed by the end of the study. Of the 566 eligible controls, 45 (9.5%) could not be traced or interviewed before the study ended and 108 (19.1%) refused to be interviewed. The overall control response rate was 60.6% (screener response rate (84.9%) multiplied by control interview response rate (71.4%)).

### *Data collection*

A structured questionnaire was administered inperson for 91% and 82% of the case and control women, respectively, with the remaining interviews conducted over the telephone. Information collected during the interview included sociodemographic factors, reproductive and menstrual histories, contraceptive and non-contraceptive exogenous hormone use, alcohol use, cigarette smoking, body size, and medical history, as well as family history of cancer. The date of diagnosis and 3 months prior to the screener date for the random digit dialing process was the reference date for the cases and controls, respectively.

Ninety percent of the cases and 87% of the controls who participated in the main study interview also self-completed a 126-item food-frequency questionnaire (FFQ), developed by Willett and colleagues, about their usual diet for the year that ended 1 year preceding the interview, *i.e.* for the time period 12–24 months prior to the interview [37]. Women classified their consumption into predefined frequency categories ranging from never or less than once per month to six or more times per day. A question was also included which allowed for other food items, eaten at least once per week, that were not specified elsewhere in the questionnaire. Subjects were queried regarding their use of oil or fat during the preparation of food items as well as about their use of vitamins and other dietary supplements. Average daily nutrient intakes were calculated from the FFQ using the Harvard Nutrient Database (23 May 1996) of food composition data. Micronutrient intake of retinol, carotene, crude fiber, folate, and vitamins A, C, and E was determined solely from dietary sources as well as

from dietary and supplementation sources. The latter either showed similar or stronger associations to the former; therefore, we present findings for micronutrients based on both dietary and supplementation sources.

#### Data analysis

Approximately 1% of the cases and of the controls were excluded because the natural log of their total energy intake was more than three standard deviations from the mean of the log transformed data [38, 39], leaving 668 cases and 347 controls for the analyses. Among the cases there were 717 BOTs, including 172 serous, 60 mucinous, 165 teratoma, 280 endometrioid, 32 fibromathecoma, and eight Brenner tumors. For subsequent analyses the data were not log transformed because doing so affects the interpretation of the coefficients.

To compare the median value of the nutrients between the cases and the controls, the Wilcoxon test was employed [40]. Pearson correlation coefficients between nutrients were also calculated [41]. Since the parametric relationships between each of the nutrients and BOTs are unknown the standard multivariate and residual nutrient methods were employed to fit continuous and categorical nutrient variables, respectively [37]. In the latter method, which provides the least biased estimate of the association for categorized nutrients [42], the residuals from a model that regressed the nutrient on total energy were quartiled among the control distribution of the nutrient and were included as indicator variables in the models. All of these models included total energy intake as a continuous variable. To assess the linear trend in the log odds of quartiles of nutrient consumption the indicator variable scores (0, 1, 2, 3) were entered as ordinal. The results from the residual nutrient technique are presented since similar findings for the standard multivariate and residual nutrient methods were observed and since the risk estimates across the quartiles did not always support a linear association.

For the nutrients associated with BOTs, we explored whether they were confounding the relation for other nutrients and BOTs as well as if there was multiplicative interaction. To assess confounding, the potentially confounding nutrient was added as a continuous variable to a model that included the residual of the other nutrient in quartiles. Multiplicative interaction was evaluated by a test of differences in the minus two log-likelihoods of models with and without the interaction term included [41]. In the interaction models the nutrients were dichotomized at the median value among the control distribution.

Unconditional logistic regression models were used to determine odds ratios (ORs) and 95% confidence intervals (CIs) [43]. Analyses were performed to compare the entire group of control women to all women with BOTs, as well as to each of the following histologic subtypes: endometrioid, mucinous, serous, and teratoma. This was done since heterogeneity by tumor subtype could not be ruled out *a priori*, due to their differing cellular origins. In addition, the previously reported associations for OCs in this study population [33], as well as the findings of several studies of malignant ovarian tumors [44–46], further suggest that the underlying etiology of these histologic subtypes may differ, including among epithelial subtypes. Given the small numbers of fibromathecoma and Brenner tumors, these were not analyzed separately. Women with multiple tumor types were included in each applicable histology specific analysis.

The models presented include the frequency matching factors, age (six groups) and hospital (seven categories) as indicator variables as well as total energy (kilocalories/day) and body mass index (BMI: weight in kilograms/height in meters squared) for the year prior to the interview, hereafter referred to as current BMI, as continuous variables. Other covariates considered independently in the models included: demographic (type of health-care provider, race, education, marital status); reproductive (gravidity, parity included as a continuous variable, age at first full-term pregnancy, abortions, miscarriages, weeks of breast-feeding included as a continuous variable, fertility (with infertility defined as meeting at least two of the following criteria: (1) a doctor was seen for help with becoming pregnant, (2) if at least 12 consecutive months were spent trying to become pregnant, or (3) at least 12 consecutive months of unprotected sex were recorded on the reproductive calendar); menstrual cycle characteristics (ages at menarche and menopause, menopausal status as pre- vs. postmenopausal, days of school or work missed due to menstrual cramps prior to age 18); use of exogenous hormones (ever-never OC use, time since last OC use ( $\leq 6$  months/6 months to 5 years/ $\geq 5$  years/never), non-OC exogenous hormone use, hormone replacement therapy); BMI (14 and 21 years of age, and current BMI); medical history (tubal ligation, hysterectomy, at least one prior chronic medical condition, history of high blood pressure, history of high cholesterol); mother or sister with ovarian cancer; and lifestyle habits (cigarette smoking; vitamin use; recreational exercise at ages 14 and 21, as well as for the year preceding the year prior to interview; alcohol use at age 21, for the year preceding the year prior to interview, and lifetime use). Unless specified otherwise, these covariates were included in the



models as indicator variables and the categorization of continuous variables was determined using the control quartile distribution. Since the addition of these covariates did not result in meaningful changes in the ORs in any of the nutrients, these factors were not included in the models that are presented.

Final models for all BOTs combined were run excluding three different groups of women: women with only a Brenner ( $n = 6$ ) or fibroma-thecoma tumor ( $n = 23$ ); women with a telephone interview ( $n = 74$ ); and women with multiple tumor types ( $n = 47$ ). Secondly, the final models were fit using 5-year categories since the 10-year age categories may not be sufficient to allow for dietary intake changes over time. Lastly, the final standard multivariate models were fit using conditional logistic regression since risk estimates from unconditional logistic regression may overestimate the association [47]. The estimates from all of these models were not materially different (data not shown).

## Results

The distributions of selected covariates, including health-care provider, race, parity, OC use, and current BMI, for the case and control women who completed a dietary questionnaire are provided in Table 1. The distributions of these factors among those with dietary information available is similar to that observed for the overall sample [33]. In general, controls were more likely to have a non-private health-care provider or no health-care provider (a possible indicator of less opportunity for diagnosis), as well as to be parous. Whereas cases were more likely to be white, never users of OCs, and have a larger current BMI relative to the controls, though these case-control differences are not significant. These relations were similar across the histology subgroups. The mean age among the 668 case women in the dietary analyses was 42.2 years (standard deviation (SD) = 11.9), which was slightly older than the mean age of 41.5 (SD = 12.5) for the 347 control women ( $p$ -value = 0.38).

In general, cases and controls had similar daily median intakes of nutrients as shown in Table 2. Though cases consumed less energy than the controls, they had slightly higher median intakes of sources (vegetable and animal) and types (monounsaturated, polyunsaturated, and saturated) of fat. The most important case-control differences were for vegetable and polyunsaturated fat (both  $p$ -values  $\leq 0.10$ ). For histologic types (data not shown), the endometrioid and teratoma case women had higher intakes, while

Table 1. Odds ratios and 95% confidence intervals for benign ovarian tumors and covariates, adjusted for age and hospital, among 1015 women in the New York Metropolitan area, 1992-1993

Covariate	Cases (n = 668)	Controls (n = 347)	OR	95% CI
Type of health-care provider				
Private	575	267	1.0	
Non-private/no care	93	80	0.6	0.4-0.8
Race <sup>b</sup>				
White	521	245	1.0	
Black	64	42	0.7	0.5-1.2
Asian	19	16	0.6	0.3-1.1
Hispanic	57	33	0.9	0.6-1.5
Mixed races	6	10	0.3	0.1-0.8
Parity				
None	297	109	1.0	
One	93	61	0.5	0.3-0.7
Two	160	107	0.4	0.3-0.6
Three	81	41	0.5	0.3-0.9
Four or more	37	29	0.4	0.2-0.6
OC use				
Never	233	111	1.0	
Ever	435	236	0.8	0.6-1.1
BMI <sup>c</sup> year prior to interview (or current BMI)				
$\leq 20.77$	151	87	1.0	
20.78-23.05	169	86	1.1	0.8-1.6
23.06-26.63	166	88	1.1	0.7-1.6
$>26.63$	180	86	1.2	0.8-1.7

Abbreviations: number (No.); odds ratio (OR); confidence interval (CI); oral contraceptive (OC); body mass index (weight in kilograms/height in meters squared, BMI).

<sup>a</sup> Adjusted for age in 10-year categories (six groups) and hospital (seven groups).

<sup>b</sup> Information on race is missing for one case.

<sup>c</sup> Information on current BMI is missing for two cases.

mucinous cases had lower median intakes of these fat nutrients. Women with serous tumors had higher median intakes of vegetable and polyunsaturated fat, but slightly lower median intakes of the other fat nutrients when compared to control women.

After adjustment for age, hospital, and current BMI, total energy was not associated with an increased risk of all BOTs combined, or with any of the specific histologic sub-types examined (Table 3). Higher consumption of total fat increased the risk of endometrioid and teratoma tumors and was suggestive, though non-significantly, of an increased risk of all BOTs combined. When sources and types of fat were examined, the strongest elevated risks were for vegetable and polyunsaturated fats. The ORs for the highest versus lowest quartile of intake of vegetable fat were elevated for all BOTs combined as well as for each of the histologic subtypes. However, an increasing trend in risk for each successive

Table 2. Median nutrient intake for all benign ovarian tumors cases and controls, among 1015 women in the New York Metropolitan Area, 1992–1993

Nutrient	Cases (n = 668)	Controls (n = 347)
Total energy (kcal)	1742.1	1813.4
Protein (g)	78.0	77.7
Total fat (g)	50.6	48.9
Animal fat (g)	31.4	31.2
Vegetable fat (g) <sup>a</sup>	23.2	21.9
Carbohydrates (g)	231.6	244.0
Saturated fat (g)	19.0	18.9
Monounsaturated fat (g)	20.4	19.9
Polyunsaturated fat (g) <sup>a</sup>	10.6	10.3
Retinol (IU)	3171.4	3328.6
Carotene (IU)	9788.9	9543.1
Crude fiber (g)	4.9	4.8
Folate (μg)	436.9	445.5
Vitamin A (IU)	14039.0	14022.7
Vitamin C (mg)	244.1	252.8
Vitamin E (mg)	13.8	12.8

Abbreviations: kilocalories (kcal); grams (g); milligrams (mg); international units (IU); micrograms (μg).

<sup>a</sup>  $p \leq 0.10$ .

quartile of intake was limited to endometrioid tumors and all BOTs combined (both  $p$ -trends  $\leq 0.05$ ). The association between polyunsaturated fat and each of the tumor subtypes, as well as for all BOTs combined, was similar to that observed for vegetable fat, except that, there was no relation for the mucinous tumors. The ORs and 95% CIs for the highest versus lowest quartile of polyunsaturated fat consumption were 2.0 (1.2–3.3), 1.0 (0.4–2.2), 1.5 (0.9–2.7), 1.6 (0.9–2.7), 1.6 (1.1–2.3), for endometrioid, mucinous, serous, teratoma, and all BOTs combined, respectively; with increasing trends in risk for all, except the mucinous, tumor type ( $p$ -trends  $\leq 0.05$ ).

For the micronutrients examined, namely retinol, carotene, crude fiber, folate, and vitamins A, C, and E, there were no uniform patterns of associations across tumor subtypes (Table 4). Within histologic-specific groups, the risk of serous tumors shows an inverse trend for vitamin A and retinol intake; the ORs for the four increasing quartiles of intake were 1.0, 0.6, 0.5, 0.5 ( $p$ -trend = 0.01) and 1.0, 0.9, 0.7, 0.6 ( $p$ -trend = 0.04), respectively.

There was no evidence of interaction between polyunsaturated and vegetable fat for all BOTs combined or for histologic subtypes (data not shown). The associations between other nutrients and BOTs did not differ whether adjusted for vegetable or polyunsaturated fat. This was not surprising, given the strong correlation

between vegetable fat and polyunsaturated fat ( $r = 0.9$  and  $p \leq 0.01$ ) and the similar correlations between these two nutrients and the other nutrients examined. Due to the strong public and scientific interest in classifying fats as saturated or unsaturated the polyunsaturated fat adjusted estimates are shown in Table 5. The previously observed elevated risks for the highest vs. lowest intakes of total, saturated, and monounsaturated fat were reduced after adjustment. Vegetable fat remained positively associated with all BOTs combined and for each of the subtypes except teratoma; however, the associations were weaker and a dose-response relation was supported only for endometrioid tumors ( $p$ -trend = 0.05). Finally, the associations between the micronutrients and the tumors were essentially unchanged (data not shown).

## Discussion

The results of this study suggest that higher intakes of vegetable or polyunsaturated fats increase the risk of BOTs. The ability to discriminate between the effects of these two nutrients in relation to BOTs is difficult given their strong correlation. Adjustment for either of these nutrients yielded similar associations for all of the other nutrients examined and BOTs. These data also suggest that there may be an association between serous BOTs and several of the micronutrients examined, particularly sources of vitamin A. Finally, these data were not supportive of a relation between BOTs (whether all tumor types were combined or by histologic type) and any of the other nutrients examined, including total, animal, saturated, or monounsaturated fat.

Data, primarily from animal studies, suggest that polyunsaturated fat may play a role in the neoplastic process [48], thereby lending credence to the observed elevated risk of BOTs with higher intakes of polyunsaturated or vegetable fats. The measure of polyunsaturated fat in this study primarily reflects intakes of omega-6, which is the class of polyunsaturated fats that has been shown to promote the growth and metastasis of tumors in laboratory studies. Further support for the underlying association relates to the fact that essential fatty acids metabolism influences prostaglandin concentrations [49], which, in turn, have been linked to the regulation of ovarian function [50]. In fact, it has been demonstrated that women treated with inhibitors of prostaglandin synthesis, such as indomethacin, can have suppressed ovulation [51]. Though the findings of this study are not biologically implausible, they are inconsistent with those of the epidemiological studies of malignant ovarian tumors, which indicate that saturated [24, 25, 27, 30] or

Table 3. Odds ratios and 95% confidence intervals for benign ovarian tumors and macronutrients, adjusted for age, hospital, total energy, and current BMI, using the residual nutrient method, among 1015 women in the New York Metropolitan Area, 1992-1993

Nutrient and quartile	Endometrioid		Mucinous		Serous		Teratoma		All cases	
	OR <sup>a</sup>	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Total energy (kcal <sup>b</sup> )										
Q1	1.0		1.0		1.0		1.0		1.0	
Q2	1.2	0.7-1.8	0.8	0.4-1.8	1.8	1.0-3.1	1.5	0.9-2.6	1.4	1.0-2.0
Q3	0.7	0.4-1.2	0.8	0.4-1.8	1.3	0.7-2.3	0.9	0.5-1.5	0.9	0.6-1.4
Q4	0.9	0.6-1.5	0.7	0.3-1.5	1.3	0.7-2.4	1.2	0.7-2.0	1.1	0.7-1.6
<i>p</i> for trend	0.36		0.37		0.61		0.82		0.79	
Carbohydrates (g)										
Q1	1.0		1.0		1.0		1.0		1.0	
Q2	1.0	0.6-1.5	0.5	0.2-1.2	1.0	0.6-1.8	0.9	0.6-1.6	1.0	0.7-1.4
Q3	1.0	0.6-1.6	0.8	0.3-1.7	1.3	0.7-2.2	0.8	0.5-1.4	1.0	0.7-1.4
Q4	0.6	0.4-1.0	1.1	0.5-2.4	1.1	0.6-1.9	0.6	0.3-1.0	0.8	0.5-1.1
<i>p</i> for trend	0.06		0.63		0.58		0.05		0.19	
Protein (g)										
Q1	1.0		1.0		1.0		1.0		1.0	
Q2	0.9	0.5-1.4	0.4	0.2-1.0	0.5	0.3-0.9	0.6	0.3-1.0	0.8	0.5-1.1
Q3	0.8	0.5-1.2	0.4	0.2-0.9	0.6	0.4-1.0	0.9	0.5-1.5	0.7	0.5-1.0
Q4	1.1	0.7-1.7	0.6	0.3-1.3	0.6	0.3-1.0	1.3	0.7-2.1	1.0	0.7-1.4
<i>p</i> for trend	0.91		0.18		0.05		0.19		0.71	
Total fat (g)										
Q1	1.0		1.0		1.0		1.0		1.0	
Q2	1.6	0.9-2.6	0.4	0.1-0.9	0.8	0.5-1.5	1.5	0.8-2.6	1.3	0.9-1.9
Q3	1.6	1.0-2.7	0.9	0.4-1.9	1.3	0.8-2.3	1.5	0.9-2.5	1.4	1.0-2.1
Q4	1.7	1.0-2.8	0.8	0.4-1.8	0.9	0.5-1.5	1.8	1.0-3.1	1.3	0.9-1.9
<i>p</i> for trend	0.05		0.97		0.99		0.06		0.16	
Animal fat (g)										
Q1	1.0		1.0		1.0		1.0		1.0	
Q2	0.9	0.6-1.5	0.8	0.4-1.9	1.0	0.6-1.8	1.1	0.6-1.9	1.0	0.7-1.5
Q3	1.1	0.7-1.7	1.2	0.5-2.8	1.0	0.5-1.7	1.1	0.6-2.0	1.0	0.7-1.5
Q4	1.0	0.6-1.5	0.9	0.4-2.2	0.6	0.4-1.2	1.3	0.8-2.3	1.0	0.7-1.4
<i>p</i> for trend	0.96		0.85		0.15		0.34		0.96	
Vegetable fat (g)										
Q1	1.0		1.0		1.0		1.0		1.0	
Q2	1.2	0.7-2.0	0.8	0.3-1.9	1.6	0.9-2.9	0.8	0.5-1.5	1.2	0.8-1.7
Q3	1.9	1.2-3.2	1.2	0.5-2.9	1.4	0.7-2.5	1.2	0.7-2.1	1.5	1.0-2.2
Q4	2.0	1.2-3.2	1.5	0.7-3.4	1.9	1.1-3.3	1.4	0.9-2.5	1.7	1.2-2.5
<i>p</i> for trend	0.001		0.18		0.07		0.08		0.003	
Saturated fat (g)										
Q1	1.0		1.0		1.0		1.0		1.0	
Q2	1.6	1.0-2.6	1.1	0.5-2.5	1.0	0.6-1.8	2.1	1.2-3.8	1.4	0.9-2.0
Q3	1.2	0.7-2.0	0.9	0.4-2.1	1.0	0.6-1.9	1.3	0.7-2.3	1.1	0.7-1.6
Q4	1.4	0.8-2.2	1.2	0.5-2.6	0.8	0.5-1.5	1.7	1.0-3.1	1.2	0.8-1.8
<i>p</i> for trend	0.45		0.85		0.59		0.26		0.56	
Monounsaturated fat (g)										
Q1	1.0		1.0		1.0		1.0		1.0	
Q2	1.4	0.8-2.3	0.8	0.3-1.9	1.0	0.5-1.7	1.0	0.6-1.8	1.0	0.7-1.5
Q3	1.3	0.8-2.1	1.2	0.5-2.6	1.1	0.6-1.9	1.6	0.9-2.8	1.2	0.8-1.7
Q4	1.7	1.1-2.8	1.0	0.4-2.2	0.8	0.5-1.4	1.4	0.8-2.4	1.3	0.9-1.8
<i>p</i> for trend	0.05		0.81		0.58		0.11		0.17	

Table 3. (Continued)

Nutrient and quartile	Endometrioid		Mucinous		Serous		Teratoma		All cases	
	OR <sup>a</sup>	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Polyunsaturated fat (g)										
Q1	1.0		1.0		1.0		1.0		1.0	
Q2	1.2	0.7-2.1	0.4	0.2-1.1	0.7	0.4-1.2	0.8	0.4-1.4	0.9	0.6-1.3
Q3	1.9	1.2-3.2	1.0	0.5-2.2	0.9	0.5-1.6	1.4	0.8-2.4	1.3	0.9-1.9
Q4	2.0	1.2-3.3	1.0	0.4-2.2	1.5	0.9-2.6	1.6	0.9-2.7	1.6	1.1-2.3
<i>p</i> for trend	0.001		0.67		0.05		0.02		0.002	

Abbreviations: body mass index (weight in kilograms/height in meters squared, BMI); odds ratio (OR); confidence interval (CI); kilocalories (kcal); grams (g).

<sup>a</sup> Adjusted for age in 10-year categories (six groups/indicator), hospital (seven groups/indicator), total caloric intake (kcal/continuous), and current BMI for the year prior to interview (continuous). Two case women are missing information on current BMI, thus there are 347 controls and 666 cases; for subtype-specific models there are 279 endometrioid, 60 mucinous, 172 serous, and 164 teratomas.

<sup>b</sup> Total energy model not adjusted for total calories.

animal fats [26], rather than [30] polyunsaturated [24, 25, 27, 29] or vegetable fats [26, 29, 30], increase the risk of ovarian tumors. In fact, only one study [24] reported a positive, albeit nonsignificant, association for the highest vs. the lowest tertile of polyunsaturated fat intake (OR and 95% CI = 1.2 (0.5-2.3)).

Our other noteworthy finding of a decreased risk of serous BOTs associated with some of the micronutrients, particularly vitamin A, is concordant with the findings of several studies examining ovarian cancer risk [23-27, 31]. It is interesting to note that the vast majority of malignant ovarian cancer tumors are epithelial in origin, primarily of the serous histologic subtype. All but one [46] of the studies examining malignant ovarian tumors combined the histologic types in their analyses. If the relations between diet and malignant tumors had been reported for the histologic subtypes then more similarities between the benign and malignant tumors might have been noted.

Since the relationship between benign and malignant ovarian tumors is unclear, consistencies or inconsistencies between studies of these different tumor types may or may not be of concern. It is unlikely that secular changes in diet account for the disparity between the findings of the malignant studies examining nutrient intakes [23-28, 30-32, 46] and this one, since most of those studies were conducted in the mid-1980s to early 1990s. Similar to this study, most of the earlier studies were case-control in design [23-27, 30-32, 46], and though none used community controls, several did use population-based controls [24, 26, 30, 46].

Women with ovarian malignant tumors may change their dietary habits as a result of the gastrointestinal discomfort from the local tumor extension to the serosal surface of the bowel. In contrast, women with BOTs are less likely to modify their dietary habits since these

tumors are generally asymptomatic. Thus, in studies of benign tumors, reported intakes are more likely to be reflective of actual current intakes. However, in studies of both of these types of tumors, it is unclear whether the reported intakes of nutrients are actually indicative of past intakes at the time of disease initiation or progression.

Recall of diet can also be inaccurate if women provide socially desirable rather than accurate responses. Although the dietary hypotheses under examination were unknown to the public at the time of the study, the issue of diet and disease receives a lot of media attention. In particular, for the past few decades Americans have been encouraged to replace their dietary intakes of saturated or animal fats with unsaturated or vegetable fats in order to reduce their risk of coronary heart disease. Thus, if the women in the study were attempting to provide socially desirable responses, then intakes of vegetable fats may have been over-reported, while intakes of animal fats may have been under-reported. This misclassification would have been nondifferential by case-control status, and therefore would have resulted in an underestimation of any of the dietary fat associations examined. On the other hand, it is conceivable that the cases may have been more health-conscious than the controls, as indicated by their higher frequency of hormone replacement therapy use. Thus, cases may truly have higher intakes of vegetable and unsaturated fats, or given their heightened awareness they may have over-reported their consumption of these fats, while under-reporting their intakes of saturated and animal fats. The associations for vegetable and unsaturated fats would be overestimated, while the associations for animal and saturated fats would be underestimated due to this differential misclassification.

Table 4. Odds ratios and 95% confidence intervals for benign ovarian tumors and micronutrients, adjusted for age, hospital, total energy, and current BMI, using the residual nutrient method, among 1015 women in the New York Metropolitan Area, 1992–1993

Nutrient and quartile	Endometrioid		Mucinous		Serous		Teratoma		All cases	
	OR <sup>a</sup>	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
<b>Retinol (IU)</b>										
Q1	1.0		1.0		1.0		1.0		1.0	
Q2	1.0	0.6–1.6	0.6	0.2–1.3	0.9	0.5–1.5	1.5	0.8–2.6	0.9	0.6–1.4
Q3	1.3	0.8–2.1	1.1	0.5–2.3	0.7	0.4–1.1	1.6	0.9–2.7	1.0	0.7–1.5
Q4	0.9	0.6–1.5	0.5	0.2–1.1	0.6	0.3–1.0	1.3	0.7–2.2	0.8	0.5–1.1
<i>p</i> for trend	0.81		0.28		0.04		0.46		0.34	
<b>Carotene (IU)</b>										
Q1	1.0		1.0		1.0		1.0		1.0	
Q2	1.2	0.7–1.9	0.9	0.4–2.3	0.6	0.3–1.1	0.7	0.4–1.3	0.9	0.6–1.3
Q3	1.4	0.8–2.3	1.1	0.5–2.6	0.8	0.4–1.4	1.0	0.6–1.8	1.1	0.7–1.6
Q4	1.0	0.6–1.7	0.9	0.4–2.1	0.6	0.3–1.0	0.8	0.4–1.3	0.7	0.5–1.1
<i>p</i> for trend	0.81		0.87		0.11		0.59		0.27	
<b>Crude fiber (g)</b>										
Q1	1.0		1.0		1.0		1.0		1.0	
Q2	1.0	0.6–1.6	0.9	0.4–2.4	0.7	0.4–1.2	1.0	0.6–1.9	1.1	0.7–1.6
Q3	0.9	0.6–1.5	1.4	0.6–3.5	0.7	0.4–1.2	1.2	0.7–2.1	0.9	0.6–1.3
Q4	1.0	0.6–1.5	1.5	0.7–3.5	0.8	0.5–1.5	1.3	0.8–2.3	1.1	0.8–1.6
<i>p</i> for trend	0.84		0.21		0.63		0.25		0.86	
<b>Folate (μg)</b>										
Q1	1.0		1.0		1.0		1.0		1.0	
Q2	1.1	0.7–1.8	1.0	0.5–2.3	0.7	0.4–1.2	1.1	0.6–1.9	1.0	0.7–1.4
Q3	1.1	0.7–1.8	0.7	0.3–1.6	0.9	0.5–1.5	1.0	0.6–1.8	1.1	0.8–1.6
Q4	1.2	0.7–1.8	0.9	0.4–2.0	0.7	0.4–1.3	0.9	0.5–1.6	0.9	0.6–1.3
<i>p</i> for trend	0.56		0.58		0.42		0.72		0.77	
<b>Vitamin A (IU)</b>										
Q1	1.0		1.0		1.0		1.0		1.0	
Q2	1.2	0.7–1.9	0.8	0.3–1.8	0.6	0.3–1.0	1.1	0.6–1.9	0.9	0.6–1.3
Q3	1.4	0.9–2.3	1.0	0.4–2.3	0.5	0.3–0.8	1.4	0.8–2.4	1.0	0.7–1.5
Q4	1.0	0.6–1.7	0.7	0.3–1.6	0.5	0.3–0.9	0.9	0.5–1.5	0.8	0.5–1.2
<i>p</i> for trend	0.74		0.52		0.01		0.86		0.36	
<b>Vitamin C (mg)</b>										
Q1	1.0		1.0		1.0		1.0		1.0	
Q2	1.4	0.9–2.2	1.1	0.4–2.6	1.1	0.6–1.8	1.1	0.7–1.9	1.2	0.8–1.7
Q3	1.0	0.6–1.6	1.2	0.5–2.7	0.9	0.5–1.6	0.7	0.4–1.2	0.9	0.6–1.4
Q4	1.3	0.8–2.0	1.1	0.5–2.5	0.8	0.5–1.4	0.9	0.5–1.5	1.0	0.7–1.5
<i>p</i> for trend	0.57		0.77		0.39		0.30		0.73	
<b>Vitamin E (mg)</b>										
Q1	1.0		1.0		1.0		1.0		1.0	
Q2	1.0	0.6–1.7	1.2	0.5–2.8	0.6	0.3–1.0	0.8	0.4–1.3	0.7	0.5–1.1
Q3	0.9	0.6–1.5	0.9	0.3–2.2	0.7	0.4–1.3	0.9	0.5–1.6	0.8	0.5–1.2
Q4	1.2	0.8–2.0	1.0	0.4–2.4	0.7	0.4–1.3	0.9	0.5–1.6	1.0	0.7–1.4
<i>p</i> for trend	0.55		0.88		0.43		0.87		0.96	

Abbreviations: body mass index (weight in kilograms/height in meters squared, BMI); odds ratio (OR); confidence interval (CI); grams (g); milligrams (mg); international units (IU); micrograms (μg).

<sup>a</sup> Adjusted for age in 10-year categories (six groups/indicator), hospital (seven groups/indicator), total caloric intake (kcal/continuous), and current BMI for the year prior to interview (continuous). Two case women are missing information on current BMI, thus there are 347 controls and 666 cases; for subtype-specific models there are 279 endometrioid, 60 mucinous, 172 serous, and 164 teratomas.

The response rates in this study were comparable to those in the three studies conducted in the United States that used population-based controls [24, 30, 46], but lower than those for the Shanghai population-based

study [26] and for the Greek study that used friends visiting hospitalized patients as controls [27]. Selection bias is a concern given the study's response rates, which were lower in the controls than in the cases. If non-

Table 5. Odds ratios and 95% confidence intervals for benign ovarian tumors and dietary fats, adjusted for age, hospital, total energy, current BMI, and polyunsaturated fat, using the residual nutrient method, among 1015 women in the New York Metropolitan Area, 1992-1993

Nutrient and quartile	Endometrioid		Mucinous		Serous		Teratoma		All cases	
	OR <sup>a</sup>	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Total fat (g)										
Q1	1.0		1.0		1.0		1.0		1.0	
Q2	1.4	0.8-2.3	0.4	0.1-0.9	0.7	0.4-1.3	1.3	0.7-2.4	1.1	0.8-1.7
Q3	1.3	0.8-2.3	0.8	0.3-1.9	1.0	0.5-1.8	1.2	0.7-2.3	1.2	0.8-1.8
Q4	1.3	0.7-2.3	0.7	0.3-1.9	0.6	0.3-1.2	1.4	0.7-2.6	1.0	0.6-1.6
<i>p</i> for trend	0.55		0.89		0.26		0.45		0.94	
Animal fat (g)										
Q1	1.0		1.0		1.0		1.0		1.0	
Q2	0.8	0.5-1.3	0.8	0.4-2.0	1.0	0.6-1.7	1.0	0.6-1.8	1.0	0.7-1.4
Q3	1.0	0.6-1.5	1.2	0.5-2.9	0.9	0.5-1.5	1.1	0.6-1.9	0.9	0.6-1.4
Q4	0.9	0.5-1.4	0.9	0.4-2.2	0.6	0.3-1.1	1.2	0.7-2.2	0.9	0.6-1.4
<i>p</i> for trend	0.68		0.88		0.09		0.45		0.69	
Vegetable fat (g)										
Q1	1.0		1.0		1.0		1.0		1.0	
Q2	1.1	0.7-2.0	0.9	0.3-2.2	1.5	0.8-2.8	0.7	0.4-1.3	1.1	0.7-1.7
Q3	1.8	1.0-3.0	1.5	0.6-4.0	1.2	0.6-2.3	1.0	0.5-1.8	1.3	0.8-2.0
Q4	1.7	0.9-3.2	2.1	0.7-5.9	1.5	0.7-3.1	1.0	0.5-2.0	1.4	0.8-2.3
<i>p</i> for trend	0.05		0.10		0.47		0.72		0.15	
Saturated fat (g)										
Q1	1.0		1.0		1.0		1.0		1.0	
Q2	1.4	0.9-2.4	1.1	0.5-2.5	0.9	0.5-1.6	1.9	1.0-3.4	1.3	0.9-1.8
Q3	1.0	0.6-1.7	0.9	0.3-2.2	0.9	0.5-1.6	1.1	0.6-2.0	0.9	0.6-1.4
Q4	1.1	0.7-1.9	1.1	0.5-2.7	0.7	0.4-1.3	1.5	0.8-2.7	1.1	0.7-1.6
<i>p</i> for trend	0.998		0.88		0.28		0.60		0.90	
Monounsaturated fat (g)										
Q1	1.0		1.0		1.0		1.0		1.0	
Q2	1.2	0.7-2.0	0.8	0.3-1.9	0.8	0.5-1.5	0.9	0.5-1.6	0.9	0.6-1.4
Q3	1.1	0.6-1.8	1.2	0.5-2.8	0.8	0.4-1.5	1.3	0.7-2.3	1.0	0.6-1.5
Q4	1.3	0.7-2.3	1.0	0.4-2.5	0.6	0.3-1.1	1.0	0.6-2.0	1.0	0.6-1.5
<i>p</i> for trend	0.47		0.85		0.10		0.64		0.99	

Abbreviations: body mass index (weight in kilograms/height in meters squared, BMI); odds ratio (OR); confidence interval (CI); kilocalories (kcal); grams (g).

<sup>a</sup> Adjusted for age in 10-year categories (six groups/indicator), hospital (seven groups/indicator), total caloric intake (kcal/continuous), current BMI for the year prior to interview (continuous), polyunsaturated fat (grams/continuous). Two case women are missing information on current BMI, thus there are 347 controls and 666 cases; for subtype-specific models there are 279 endometrioid, 60 mucinous, 172 serous.

response is related to the exposures of interest, *i.e.* dietary habits, the effect on the estimates of the associations would be biased. Women who agree to participate in a health-related study may be more health-conscious than those who do not, thus their dietary habits may differ. Thus, it is possible that the women who did not to participate in the study may be those with lower intakes of unsaturated fats but higher intakes of saturated fats. Under this scenario the animal or saturated fat associations examined would have been biased away from the null, while the vegetable or unsaturated fat associations have been biased towards the null.

The use of community controls as a comparison group for this asymptomatic disease may also be problematic. If community controls did not have equal access to healthcare, then they might have an undiagnosed tumor which could result in an underestimation of the associations. Several approaches were used to evaluate this. Cases were more likely than the controls to have private physicians; however, the inclusion of this variable in the multivariate analysis did not appear to confound any of the associations in a meaningful way. Additionally, we examined other indicators of healthcare use, which would allow opportunities for diagnosis, such as number of sonograms and pap smears.

Although case women had slightly more of these medical tests than control women, both groups of women were frequently having these tests. Since these control women had opportunities for diagnosis of BOTs, and given that the incidence of these tumors is low, using them as a comparison group was unlikely to result in a strong bias of the estimates towards the null.

In conclusion, this case-control study provides the first evidence that polyunsaturated fat or vegetable fat may possibly increase the risk of being diagnosed with a benign ovarian tumor. Although homogeneity of dietary relationships across tumor types was not expected *a priori*, fairly consistent elevated risks for the fourth compared to the first quartile were found for both of these nutrients and most histologic subtypes. Even

though there is some biological plausibility for the observed relationships, primarily based on animal studies, these associations were not hypothesized *a priori*. These findings could be due to chance given the number of multiple comparisons made in this study; thus they require replication in future studies. Additionally, the risk of serous tumors was reduced for the highest quartile of intake of the micronutrients examined, with inverse trends noted for both vitamin A and retinol. Though no other remarkable dietary associations were observed, the possibility that there are other relationships between nutrients and these tumors cannot be dismissed, especially in light of the limited power of this study to detect such associations.

Appendix Table 1. Quartiles of nutrient intake and number of cases and controls by quartile of consumption, among 1015 women in the New York Metropolitan area, 1992-1993

Nutrient and quartiles of intake	Cases					
	Controls (n = 347)	Endometrioid <sup>a</sup> (n = 280)	Mucinous (n = 60)	Serous (n = 172)	Teratoma <sup>a</sup> (n = 165)	All <sup>a</sup> (n = 668)
Total Energy (kcal)						
<1337.49	87	70	19	37	34	153
1337.49-1813.42	87	84	15	56	54	209
1813.43-2337.07	87	58	15	37	34	143
>2337.07	86	68	11	42	43	163
Protein (g)						
<59.41	87	75	24	60	44	194
59.41-77.69	87	71	11	34	27	151
77.70-100.85	87	56	10	41	39	133
>100.85	86	78	15	37	55	190
Total fat (g)						
<34.87	87	47	20	44	30	137
34.87-48.85	87	76	8	36	41	169
48.86-68.13	86	77	16	52	44	180
>68.13	87	80	16	40	50	182
Animal fat (g)						
<21.48	86	68	16	50	35	163
21.48-31.23	87	66	14	48	40	168
31.24-44.61	89	77	17	42	44	176
>44.61	85	69	13	32	46	161
Vegetable fat (g)						
<14.90	88	49	12	29	39	130
14.90-21.90	86	53	12	45	30	145
21.91-29.19	86	88	15	39	44	175
>29.19	87	90	21	59	52	218
Carbohydrates (g)						
<167.55	86	82	17	40	49	182
167.55-244.04	89	75	10	42	45	183
244.05-313.10	85	75	14	48	43	165
>313.10	87	48	19	42	28	138
Saturated fat (g)						
<13.07	85	54	15	44	27	141
13.07-18.87	88	80	18	51	53	194
18.88-29.96	87	70	11	39	35	152
>29.96	87	76	16	38	50	181

Appendix Table 1. (Continued)

Nutrient and quartiles of intake	Cases					
	Controls (n = 347)	Endometrioid <sup>a</sup> (n = 280)	Mucinous (n = 60)	Serous (n = 172)	Teratoma <sup>a</sup> (n = 165)	All <sup>a</sup> (n = 668)
Monounsaturated fat (g)						
<13.85	85	50	17	46	34	147
13.85-19.85	89	73	11	40	34	156
19.86-27.48	87	70	17	46	51	174
>27.48	86	87	15	40	46	191
Polyunsaturated fat (g)						
<7.08	86	48	17	39	37	142
7.08-10.27	89	55	8	29	27	126
10.28-13.65	86	83	18	38	48	176
>13.65	86	94	17	66	53	224
Retinol (IU)						
<1339.03	87	68	17	51	32	176
1339.03-3328.62	87	68	12	46	45	168
3328.63-6162.58	88	88	20	38	49	185
>6162.58	85	56	11	37	39	139
Carotene (IU)						
<6204.12	86	67	14	50	49	182
6204.12-9543.10	87	75	15	35	38	156
9543.11-16782.83	87	80	17	50	45	199
>16,782.83	87	58	14	37	33	131
Crude fiber (g)						
<3.44	88	77	12	46	39	170
3.44-4.78	83	70	12	40	38	172
4.79-6.90	90	63	17	38	42	149
>6.90	86	70	19	48	46	177
Folate (μg)						
<282.68	88	68	15	47	41	168
282.68-445.54	86	67	17	36	43	162
445.55-685.97	87	74	11	48	45	183
>685.97	86	71	17	41	36	155
Vitamin A (IU)						
<8753.32	87	69	16	58	41	182
8753.32-14,022.65	87	72	13	37	45	163
14,022.66-22,453.65	86	83	18	35	48	181
>22,453.65	87	56	13	42	31	142
Vitamin C (mg)						
<136.63	90	68	13	43	46	171
136.63-252.82	85	81	13	46	52	184
252.83-539.03	86	59	17	43	31	149
>539.03	86	72	17	40	36	164
Vitamin E (mg)						
<5.71	92	68	15	52	43	190
5.71-12.83	79	77	17	32	37	133
12.84-46.62	88	58	11	41	45	158
>46.62	88	77	17	47	40	187

Abbreviations: kilocalories (kcal); grams (g); milligrams (mg); international units (IU); micrograms (μg).

<sup>a</sup> One woman with a teratoma and one with an endometrioid tumor were missing information on body mass index (weight in kilograms/height in meters squared). As a result these women were not included in the logistic models.



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## Breast Cancer Risk in Relation to Adipose Concentrations of Organochlorine Pesticides and Polychlorinated Biphenyls in Long Island, New York<sup>1</sup>

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### Abstract

To assess a possible etiological role of organochlorine compounds in breast cancer development on Long Island, a high-risk region of New York State, concentrations of organochlorine pesticides and polychlorinated biphenyls (PCBs) were measured in the adipose tissue of 232 women with breast cancer and 323 hospital controls admitted to surgery for benign breast disease or non-breast-related conditions. Seven pesticide residues and 14 PCB congeners were assayed via a supercritical fluid extraction method followed by gas chromatography with electron capture detection. After adjustment for age and body mass index, which were strongly correlated with organochlorine levels, adipose concentrations of 1,1-dichloro-2,2-di(4-chlorophenyl)ethylene, total pesticides, and total polychlorinated biphenyls (PCBs) did not differ significantly between cases and controls. The relative abundance of individual pesticide species and PCB congeners was similar in cases and controls. Odds ratios adjusted for age, BMI, hospital, and race gave no evidence of a dose-response for 1,1-dichloro-2,2-di(4-chlorophenyl)ethylene, total pesticides, or total PCBs, whether stratified by estrogen receptor status or not. Breast cancer risk among Long Island residents was not elevated compared with residents of the adjacent New York City borough of Queens. We did not confirm a previously reported association between breast cancer risk and levels of PCB congener 118 (2,3',4,4',5-pentachlorobiphenyl), nor did we observe an association with the most abundant congener 153 (2,2',4,4',5,5'-hexachlorobiphenyl), a strong inducer of phase I enzymes

that was reported recently to have estrogenic properties. Only PCB congener 183 (2,2',3,4,4',5',6-heptachlorobiphenyl), which is also an inducer, was significantly associated with risk, with an adjusted odds ratio of 2.0 (95% confidence interval, 1.2-3.4) in women with adipose levels >5.67 ng/g; the biological importance of this observation is unclear without confirmation in additional studies. Although neither the present nor other studies have provided convincing evidence of an association between body burden of 1,1,1-trichloro-2,2-bis(4-chlorophenyl)ethane and PCBs with cancer of the breast, these compounds are rated as "possible" and "probable" human carcinogens, respectively, by the International Agency for Research on Cancer. Investigations of associations with cancer at other sites should be carried out.

### Introduction

Breast cancer is the most common type of cancer diagnosed in women nationally (1), as well as in New York State (2). The many established risk factors do not fully explain its incidence or geographic variation (3, 4). Wide intra- and international variation, as well as changes in rates in successive generations of migrants, suggest that lifestyle and environmental factors affect breast cancer risk (5).

Until the early 1990s, few epidemiological studies of potential environmental risk factors for breast cancer had been carried out. Since then, a great many studies have been reported, with a special emphasis on exposure to "environmental estrogens," so-called because they include chemicals or groups of environmentally persistent chemicals that also exhibit estrogenic activity in model systems (6, 7). These include the broad class of OCCs<sup>3</sup> used as pesticides, such as *p,p'*-DDT and its breakdown products, and the more narrowly defined group of PCBs.

Associations between breast cancer risk and either serum or adipose levels of *p,p'*-DDT or related compounds as well as PCBs have been reported in a number of case-control and cohort studies beginning in 1976. Significant associations between *p,p'*-DDE and/or PCB levels and breast cancer risk have been reported in at least five studies ranging from a very small study in Brazil (8) and a pilot study in Connecticut (9), to larger studies in Quebec (10, 11), New York City (12), and a study in

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<sup>3</sup> The abbreviations used are: OCC, organochlorinated compound; OCP, organochlorinated pesticide; *p,p'*-DDE, 1,1-dichloro-2,2-di(4-chlorophenyl)ethylene; *o,p'*-DDD, 1,1-dichloro-2-(*ortho*-chlorophenyl)-2-(*para*-chlorophenyl)ethane; *p,p'*-DDT, 1,1,1-trichloro-2,2-bis(4-chlorophenyl)ethane; BMI, body mass index; BZ, Ballschmiter and Zell; HCB, hexachlorobenzene;  $\beta$ -HCH,  $\beta$ -hexachlorocyclohexane; PCB, polychlorinated biphenyl; OR, odds ratio; CI, confidence interval; LOD, limits of detection; PB, phenobarbital; ER, estrogen receptor.

Upstate New York in which the association was confined to a subgroup of parous women who had not breastfed (13). A nested case-control study by Krieger *et al.* (14) showed no overall elevation in risk, although Savitz (15) suggested a positive interpretation for *p,p'*-DDE based among separate strata of whites and blacks. Most later reports, however, have shown little or no association between exposure to OCCs and breast cancer risk, whether assessed using adipose tissue (16–19) or serum or plasma (20–23). In an otherwise negative study, Demers *et al.* (11) reported a dose-related risk of breast cancer and organochlorine exposure for cancers only for tumors >2 cm in size with lymph node involvement. A summary of study findings published through 1999 was published recently by Helzlsouer *et al.* (21).

There has been particular interest and concern among residents of the Northeastern United States, where breast cancer rates are high. Public concern has been especially strong in New York State's two easternmost counties, Nassau and Suffolk, generally referred to as Long Island (excluding coterminous parts of New York City). Excluding New York City, Nassau and Suffolk ranked first and second, respectively, among New York State counties in the average numbers of new cases of breast cancer diagnosed per year in 1991–1995, with a combined total of 1961 annual cases (2). In the same period, Nassau County's incidence rate ranked second and Suffolk's was tenth among the 62 counties of New York State. Kulldorf *et al.* (24) have shown that an unusually high rate of breast cancer on Long Island qualifies it as one of four clusters in the Northeastern region of the United States. Intense concern among local residents led to Federal legislation under which the National Cancer Institute initiated a group of epidemiological studies known as the Long Island Breast Cancer Study Project, one of whose goals is to examine the possible etiological role of environmental factors among Long Island residents (25, 26). Other risk factors targeted by the legislation were contaminated drinking water, sources of indoor and ambient air pollution, including emissions from aircraft, electromagnetic fields, pesticides and other toxic chemicals, and hazardous and municipal waste.

The present study was carried out in response to the section of the legislative mandate which targets "pesticides and other toxic chemicals" by examining the association of breast cancer risk diagnosed in Long Island women with their body burden of OCCs.

## Materials and Methods

**Study Participants.** A hospital-based case-control study was conducted from October 1994 through October 1996 in the two largest hospitals serving the Long Island population: Long Island Jewish Medical Center (New Hyde Park, NY) and North Shore University Hospital (Manhasset, NY). Both hospitals serve sections of New York City (primarily in the borough and county of Queens) as well as Nassau and Suffolk Counties. No restrictions were placed upon residence of study participants. Patients scheduled for breast biopsies and/or surgery were identified through frequent contacts with breast physicians affiliated at both hospitals and by consulting the lists of patients scheduled for presurgical testing. Cases were women newly diagnosed with malignant breast cancer or carcinoma *in situ*. Controls included patients diagnosed with benign breast diseases and women undergoing non-breast-related surgery in which small amounts of adipose tissue would ordinarily be removed.

All patients signed consent forms that were approved by

the Institutional Review Boards of the American Health Foundation and the two hospitals. Patients were met at the presurgical testing units of both hospitals by trained interviewers who administered structured face-to-face interviews about medical history, reproductive and other breast cancer risk factors, diet, smoking, and family history. More than 95% of eligible patients approached by interviewers agreed to participate. Patients were asked to provide a blood sample (usually taken as an "extra" tube during the preadmission blood drawing) and also for permission for us to obtain ~0.5 g of adipose tissue from a subsequent surgical procedure. Diagnoses and classification into case or control groups were based upon review of pathological reports subsequent to the surgical procedures. Thus, in most instances the patients, interviewers, physicians, and the investigators were unaware of the definitive case or control status of the patient until after the questionnaire data and biological samples had been obtained.

A total of 1030 patients (359 cases and 671 controls) were interviewed and contributed either adipose tissue, serum, or both. Adipose tissue samples were obtained from 86% and serum from 94% of all women enrolled in the study. Adipose tissue analyses were completed for 232 cases (199 invasive and 33 carcinoma *in situ*) and 323 controls (250 benign breast and 73 surgical patients); the remaining samples have been stored frozen for future studies. The present analysis is based upon body burden of OCCs using adipose tissue for these 555 subjects. The 73 surgical control women were admitted for procedures involving the gallbladder ( $n = 33$ ), removal of lipomas ( $n = 8$ ), abdominal hernias ( $n = 7$ ), osteoarthritis ( $n = 4$ ), and other disorders unrelated to the breast. The mean levels of DDE, total pesticides, and total PCBs did not differ significantly between controls with benign breast disease and controls with other conditions. Samples were received in separate batches from the two hospitals and analyzed in the order received, with analytical batches alternating between the hospitals. The women whose adipose tissues were analyzed did not differ significantly from the remainder of study subjects with respect to age, menopausal status, education, religion, or family history of breast cancer. In other words, selection from the sample pool did not appear to be biased with respect to important breast cancer risk factors.

**Laboratory Methods.** Levels of OCP/PCB in adipose tissue were determined using an analytical procedure developed in our laboratory for this study (27). The method is based on supercritical fluid extraction and simultaneous *in situ* removal of the bulk of fat on a partially deactivated neutral alumina sorbent, additional clean-up of supercritical fluid extracts by adsorption column chromatography also on a partially deactivated neutral alumina sorbent to remove the remaining traces of fat, and analysis by capillary gas chromatography with electron capture detection. We previously used this procedure to describe OCP/PCB partitioning between serum and adipose tissue (28).

The assay consists of extraction of a small amount of tissue (0.1–0.3 g) to which  $\gamma$ -chlordane has been added as an internal standard, with supercritical  $\text{CO}_2$ . The extraction with  $\text{CO}_2$  is carried out twice (both in static and dynamic modes). To assure the quantitative recovery of all OCPs/PCBs, including the more polar compounds, an additional extraction step with  $\text{CO}_2$  modified with 5% dichloromethane is carried out in both static and dynamic modes as before. Removal of residual traces of lipids from OCP/PCB extracts by adsorption column chromatography is an essential part of the assay because they interfere with gas chromatography-electron capture detection analysis. The 10 g of alumina (activity II–III) in the column

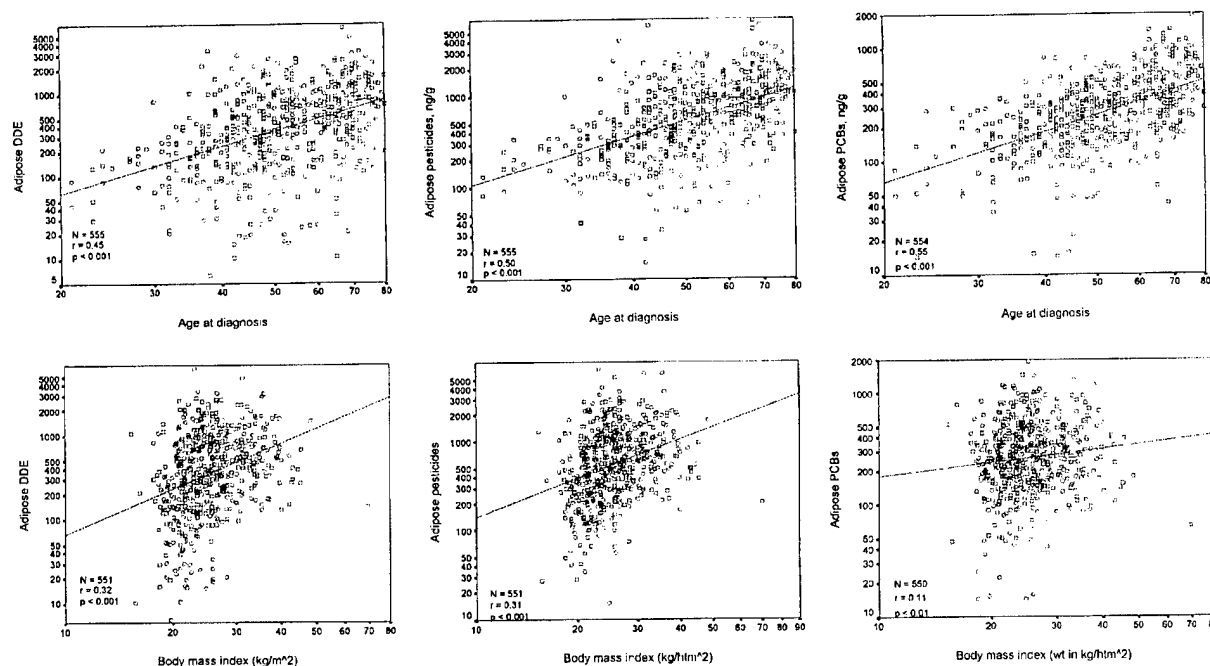


Fig. 1. Scatter plots (log-log scale) of  $p,p'$ -DDE, total OCPs, and total PCBs versus age at diagnosis (upper panel) and BMI (lower panel) for 555 cases and controls. The regression line is also shown.

provides enough surface to retain all of the lipids, whereas the choice and amount of solvents enable complete elution of all analytes. Aldrin is added to each sample prior to gas chromatographic analysis. We have not observed any background in the areas of elution of  $\gamma$ -chlordane and Aldrin, justifying the usage of these two compounds as a recovery and gas chromatography standard, respectively. Only assays with recoveries of  $\gamma$ -chlordane that exceeded 90% are reported. Our methodology was validated against samples of Certified Reference Material 430 (CRM 430; pork fat containing known concentrations of OCPs) purchased from the European Community Bureau of Reference, Brussels, Belgium. Recoveries of the OCPs ranged from 92.3% for DDE to 115% for HCB, and coefficients of variation ranged between 2.0% ( $\beta$ -HCH) and 6.3% (HCB; Ref. 27). Coefficients of variation for the targeted PCB congeners ranged between 4.2% (BZ 187) and 8.4% (BZ 180), based on a series of five assay replicates using CRM 430 to which known quantities of specific congeners were added. Operational quality control procedures also included daily calibration of instrumentation with a complete mixture of OCC pesticides and the PCB congeners of interest, using Aldrin as an internal standard. We have previously reported our LOD (28), which are based upon the IUPAC and American Chemical Society definition as the smallest concentration that is statistically different from an analytical blank (29). The LOD were 0.231 ng/g for both  $p,p'$ -DDE and  $\beta$ -HCH, 0.116 ng/g for HCB, and 0.723 ng/g BZ 153 and ranged between 0.07–0.72 ng/g for all other OCCs.

**Statistical Analysis.** Analytes were considered individually or summed into related groups. Seven OCPs or their products were measured:  $p,p'$ -DDE,  $p,p'$ -DDT, and  $o,p'$ -DDD ( $p,p'$ -DDE is the major breakdown product of  $p,p'$ -DDT), oxychlordane and *trans*-nonachlor (products of chlordane),  $\beta$ -HCH, and HCB. Fourteen PCB congeners were measured individually

[the IUPAC nomenclature suggested by Ballschmiter and Zell (30) is used]: BZ 74, 99, 118, 138, 146, 153, 156, 167, 170, 172, 178, 180, 183, and 187. Total PCBs in this report means the sum of the concentrations of these 14 species. Proportions of women with detectable levels of individual analytes (*i.e.*, levels above the instrumental LOD) were compared between cases and controls via  $\chi^2$  with Yates correction.

The  $\log_{10}$  of the concentrations of  $p,p'$ -DDE, total pesticides, and total PCBs exhibited near-normality. Therefore, means of log-transformed adipose concentrations of the target analytes were compared between cases and controls using analysis of covariance, with age at diagnosis and BMI as continuous covariates. Associations among continuous variables were assessed with Spearman correlation coefficients, which are based upon rank orders and therefore provide comparable results with both untransformed and transformed variables. Fig. 1 shows that these concentrations were correlated with both age at diagnosis and BMI (weight/height<sup>2</sup> in kg/m<sup>2</sup>). ORs for breast cancer risk were computed via unconditional logistic regression, with adjustment for age at diagnosis and BMI, as well as hospital and race. Exposure variables were grouped by tertiles of their respective distributions among controls. The *P*s for trends in the ORs were obtained by entering an indicator variable with values 0, 1, and 2, representing the tertiles as an ordinal variable in the logistic models.

## Results

Characteristics of the 232 cases and 323 controls are shown in Table 1. The controls were younger than cases, reflecting the younger average age at diagnosis for benign breast diseases compared with breast cancer. This led to a greater proportion of cases (59%) being postmenopausal compared with controls

Table 1 Characteristics of cases and controls in the Long Island Study population

	Cases (n = 232)		Controls (n = 323)		P
	n	%	n	%	
Age					
<50	79	34	178	55	<0.001
50–59	55	24	66	20	
60–69	54	23	48	15	
70–82	44	19	31	10	
Education					
≤ High school	90	39	112	35	0.61
≤ College graduate	90	39	135	42	
Postgraduate	52	22	76	24	
Race					
White	205	88	286	89	0.95
Non-white	27	12	37	11	
Residence					
New York City	98	42	129	40	0.93
Nassau	99	43	147	46	
Suffolk	29	13	39	12	
Other	6	3	8	2	
Religion					
Protestant	27	12	34	11	0.09
Catholic	89	38	158	49	
Jewish	97	42	113	35	
Other/nonc/refused	19	8	18	6	
First-degree family history of breast cancer					
No	191	83	285	89	0.05
Yes	40	17	37	11	
BMI					
≤23.03	67	29	119	37	0.16
23.04–27.01	78	34	105	33	
≥27.02	83	36	99	31	
Menopausal status					
Premenopausal	94	41	181	56	<0.001
Postmenopausal	136	59	140	44	
Age at menopause					
≤49	28	21	52	37	<0.01
50	42	31	41	29	
≥51	64	48	46	33	
Age at first live birth, parous women					
<23	54	26	86	34	0.13
23–26	73	35	84	33	
≥27	84	40	84	33	

(44%) and underscores the necessity for age-adjustment of risk estimates. Controls as a group were similar to cases in education, race, BMI, age at first live birth, and county of residence, with 57% of cases and controls residing in Long Island and all but 2% of the remainder living in New York City. Associations between breast cancer and its well-known risk factors did not differ significantly between Long Island and New York City residents. A significantly greater proportion of cases reported a history of breast cancer in a first-degree relative (17% versus 11%;  $P = 0.05$ ) as expected. Late age at menopause was strongly associated with increased breast cancer risk, with an adjusted OR of 2.31 (95% CI, 1.2–4.3) for women who experienced menopause after age 50 relative to those who underwent menopause before age 50.

Measured levels of  $p,p'$ -DDE were above LOD for all women. Levels of all analytes were above detection limits in >95% of all cases and controls, except for  $\beta$ -HCH (above LOD in 94.1% of controls),  $p,p'$ -DDT (93.2%), and four of the PCB congeners: BZ 167, 172, 178, and 183, all of which were detected in at least 69% of subjects. For all pesticides except

$\beta$ -HCH, and for the majority of PCB congeners, there were no significant differences between cases and controls in the percentage detected. However,  $\beta$ -HCH exceeded LOD in a significantly higher proportion of cases than controls (98.3% versus 94.1%;  $P < 0.05$ ) and for three PCB congeners: BZ 167 (85.7% versus 75.5%;  $P < 0.001$ ), BZ 172 (73.2% versus 69.3%;  $P < 0.001$ ), and BZ 183 (97.0% versus 91.6%;  $P < 0.05$ ).

Table 2 shows the median, 25th, and 75th percentiles of the adipose concentrations of all 21 OCCs and the percentage that each analyte makes on average relative to total pesticides or to total PCBs.  $p,p'$ -DDE comprised 73.3% of total pesticides in cases and 75.5% in controls. The difference (2.2%) was the largest observed for any of the 21 analytes; the majority of pesticides differed in abundance between cases and controls by <1%. Unadjusted concentration parameters were generally higher for cases than for controls because of the greater average age of cases and the strong correlation between age and OCC levels (Fig. 1). After adjustment for age at diagnosis and BMI, cases and controls did not differ significantly in  $\log_{10}$  mean levels of total pesticides or PCBs ( $P$ s shown in Table 2). Residue levels of the seven individual pesticides and 14 PCB congeners did not differ significantly between cases and controls except for  $p,p'$ -DDT (geometric mean, 13.6 versus 13.4 ng/g;  $P = 0.04$ ) and for 2 of the 14 PCB congeners: BZ 74 (27.6 versus 26.8 ng/g;  $P < 0.01$ ) and BZ 183 (5.9 versus 4.3 ng/g;  $P = 0.02$ ).

Associations between  $p,p'$ -DDE, total pesticides, and total PCBs and other risk factors are shown as Spearman correlation coefficients in Table 3. Organochlorine body burden was significantly correlated with age and number of full-term pregnancies. All analytes were negatively correlated with education and age at first full-term pregnancy. BMI was correlated with pesticide levels but not with total PCBs. Adipose measures of body burden were not correlated with either age at menarche or age at menopause. Concentrations of PCBs (but not pesticides) were negatively associated with months of lactation, *i.e.*, women who had lactated for longer periods of time had lower levels.

Associations between breast cancer risk and body burden of  $p,p'$ -DDE, total pesticides, and total PCBs are shown in Table 4 as adjusted ORs. Adipose OCC levels were represented by tertiles of concentration among controls. The magnitude of the largest OR was 1.27 (95% CI, 0.80–2.02) for the middle tertile of total pesticides. There were no significant ORs or trends. Findings were unchanged when controls were restricted to the 250 women with benign breast disease. Table 5 shows ORs stratified by ER level classified as ER+ and ER–. The OR for the second tertile of total OCPs among ER– women increased to 2.36 (95% CI, 1.14–4.88), but the OR for ER– women in the highest tertile was 0.93 (95% CI, 0.37–2.33), and the trend was not significant. In interaction analyses (not shown), there were no significant interaction terms between menopausal status and body burden of exposure to OCCs. Findings were unchanged when restricted to parous women who did not breast feed (data not shown).

Adjusted ORs were also computed for the six pesticide residues besides  $p,p'$ -DDE and 14 PCB congeners, with each species categorized as low (reference), medium, or high on the basis of its distribution among controls. As was the case with  $p,p'$ -DDE, none of the six other pesticide species was associated with a significantly increased risk of breast cancer at any concentration above the reference level. For 12 of the 14 measured PCB congeners, there were no significantly elevated risks among women with either medium or high adipose levels. Among women with a medium level of BZ 156 (5.87–13.59

Table 2 Median, 25th, and 75th percentiles of concentrations (ng/g) of individual pesticide residues and PCB congeners in adipose tissue and the percentage each makes of total concentration

	Cases (n = 232)			% of total OCPs	Controls (n = 323)			% of total OCPs	P <sup>a</sup>
	25%	50%	75%		25%	50%	75%		
Pesticide residue									
HCB	12.4	17.8	26.0	2.4	10.6	16.3	21.8	2.5	0.5
β-HCH	10.2	19.8	39.4	5.1	8.7	15.8	29.2	4.4	0.4
OXC <sup>b</sup>	28.4	46.4	71.7	6.6	23.8	38.9	64.8	6.2	0.06
TNC	32.0	51.0	81.6	7.3	25.2	39.6	63.8	6.6	0.9
p,p'-DDE	204.9	419.2	803.8	73.3	161.6	374.1	837.5	75.5	0.2
o,p'-DDD	8.3	16.4	27.6	2.8	7.8	13.3	22.0	2.4	0.9
p,p'-DDT	7.5	12.3	21.4	2.5	6.3	12.1	21.9	2.5	0.04
Total OCPs	359.2	628.6	1080.1	100.0	271.8	546.9	1094.5	100.0	0.1
BZ number									
74	15.8	29.6	46.2	9.9	15.1	26.7	45.6	11.1	<0.01
99	11.3	19.3	31.3	6.7	8.2	13.9	25.1	6.5	0.2
118	15.9	30.4	53.9	11.5	13.1	24.0	42.0	11.2	0.9
138	16.0	28.7	47.0	9.9	12.4	21.7	36.1	8.9	0.08
146	5.0	9.2	14.7	3.1	4.2	6.9	11.6	3.0	0.8
153	47.2	76.1	112.4	24.4	39.2	63.1	99.4	24.2	0.6
156	7.0	11.2	17.6	3.9	4.8	9.1	15.6	4.1	0.8
167	0.8	1.7	3.2	0.8	0.2	1.3	2.4	0.8	0.7
170	8.4	13.5	19.5	4.1	6.5	11.2	17.5	4.3	0.8
172	0.0	2.4	4.1	1.4	0.0	1.6	3.7	1.2	0.7
178	2.3	3.9	6.8	1.4	1.5	3.0	5.3	1.5	0.9
180	24.4	42.4	67.2	14.8	19.2	33.7	61.8	15.8	0.9
183	3.4	5.8	9.0	2.3	2.4	4.0	6.7	1.8	0.02
187	10.0	16.2	26.5	5.7	7.5	12.8	21.5	5.5	0.5
Total PCBs	184.9	294.7	458.1	100.0	156.5	257.1	382.4	100.0	0.9

<sup>a</sup> P for comparison of logarithms of case-control means, adjusted for age and BMI.<sup>b</sup> OXC, oxychlordane; TNC, trans-nonachlor.

Table 3 Spearman correlations between breast cancer risk factors and adipose levels of DDE, total OCPs, and total PCBs among 323 controls, Long Island, New York, 1994–1996

Risk factor	n	DDE (ng/g)	Total OCP <sup>a</sup> (ng/g)	Total PCB <sup>a</sup> (ng/g)
Reference age (yr)	323	0.465 <sup>b</sup>	0.508 <sup>b</sup>	0.524 <sup>b</sup>
Education (yr)	323	-0.246 <sup>b</sup>	-0.258 <sup>b</sup>	-0.180 <sup>b</sup>
BMI	323	0.354 <sup>b</sup>	0.351 <sup>b</sup>	0.105
Age at menarche (yr)	323	0.002	0.013	0.025
No. of full-term pregnancies	323	0.247 <sup>b</sup>	0.260 <sup>b</sup>	0.198 <sup>b</sup>
Age at first full-term pregnancy (yr) <sup>c</sup>	255	-0.209 <sup>b</sup>	-0.230 <sup>b</sup>	-0.215 <sup>b</sup>
Breastfed (mo) <sup>c</sup>	255	-0.097	-0.095	-0.175 <sup>b</sup>
Age at menopause (yr) <sup>d</sup>	140	0.085	0.089	0.162

<sup>a</sup> OCP, sum of seven organochlorine pesticide species; PCB, sum of 14 congeners; see text for details.<sup>b</sup> P < 0.01.<sup>c</sup> Parous women only.<sup>d</sup> Postmenopausal women only.

ng/g), the OR relative to the reference level (<5.87 ng/g) was 1.9 (95% CI, 1.1–3.0) but fell to 1.5 (95% CI, 0.9–2.5) at the highest body burden (13.60 ng/g), which was not significant. A significant dose-related increase in risk was observed for the heptachlorinated species BZ 183. Relative to women with adipose levels of 3.15 ng/g or less, the OR for levels in the range 3.16–5.66 ng/g was 1.3 (95% CI, 0.8–2.1), and for BZ 183 concentrations of 5.67 ng/g and above, it was 2.0 (95% CI, 1.2–3.4).

Because cases and controls were drawn both from Long Island and neighboring New York City, it was of interest to test whether OCC levels in control patients differed between the two regions. Among controls, the mean adipose levels of p,p'-DDE, total pesticides, and PCBs did not differ significantly between residents of Long Island and adjacent Queens County. Levels of two individual analytes, β-HCH and BZ 167, did

differ significantly (P < 0.05), with the mean level of β-HCH higher among Queens residents than among Long Island residents. There were no significant residence effects for p,p'-DDE, total pesticides, or total PCBs. When analyses were restricted to Long Island residents, there were no significant effects attributable to county of residence (i.e., Nassau versus Suffolk) for any analyte; however, only 29 cases and 39 controls were Suffolk County residents, so that these tests had limited power to detect intercounty differences in body burden.

## Discussion

The present analysis for the Long Island population is consistent with numerous studies in other populations that have shown little association between OCC body burden and breast cancer risk. Strengths of the study include a large number of cases and

Table 4 ORs for breast cancer in Long Island, New York, 1994–1996, in relation to adipose DDE, total OCPs, and total PCBs

Concentration in adipose tissue (ng/g)	Cases (n = 232)	Controls (n = 323)	Adjusted OR <sup>a</sup>	95% CI
<b>DDE</b>				
≤212.92	60	108	1.00	
212.93–618.81	86	108	1.14	0.71–1.81
>618.81	86	107	0.74	0.44–1.25
P-trend			0.3	
<b>OCP<sup>b</sup></b>				
≤340.13	54	108	1.00	
340.14–878.14	98	108	1.29	0.80–2.08
>878.14	80	107	0.66	0.38–1.17
P-trend			0.1	
<b>PCB<sup>b</sup></b>				
≤181.81	55	108	1.00	
181.82–332.24	74	108	1.06	0.67–1.69
>332.24	103	107	1.01	0.60–1.69
P-trend			0.9	

<sup>a</sup> Adjusted for age and BMI (continuous), hospital (two hospitals, indicator), race (white versus non-white, indicator).

<sup>b</sup> OCP, sum of seven organochlorine pesticide species; PCB, sum of 14 congeners; see text for details.

controls, a low refusal rate for both cases and controls, and collection of all biological samples prior to treatment. The latter point is important because of concern that cancer treatment may affect subsequently measured levels of OCCs (31). Although the two interviewers could not be completely blinded to the suspected diagnoses, all interviews were conducted prior to biopsy or other surgery so that diagnostic confirmation was always made subsequent to the interview.

The control group consisted of 250 patients with benign breast disease and 73 admitted for other surgical procedures not related to conditions of the breast or other gynecological conditions, primarily gallbladder and hernia operations. The ORs calculated using only benign breast or only surgical controls did not differ materially from the ORs using the combined control group. Miller has argued that choosing as controls women with benign breast conditions, apart from the availability of breast adipose tissue, has the advantage that the women in this group have entered the study via a selection mechanism that is nearly identical to that of the cases (32). The drawback is that some forms of benign breast disease (e.g., those with a high proportion of atypia) may themselves be risk factors for breast cancer. If these types are caused by OCCs, the result would be to overmatch controls to cases on exposure. However, review of pathological reports for the controls with benign breast disease showed that fewer than 4% of women with benign breast disease diagnoses had any mention of atypia, so this is not considered a serious concern in this control group. In addition, Zheng *et al.* (18) reported comparable levels for both *p,p'*-DDE and *p,p'*-DDT in adipose tissue of 91 women diagnosed with breast cancer compared with levels in 95 women with proliferative benign breast disease.

Interviewers attempted to frequency-match control patients on age. However, the age distribution of women with benign breast disease was somewhat younger than that of women with breast cancer, so that the goal of frequency matching could not be completely achieved. Therefore, age adjustment was an essential component of all risk calculations. The strong positive correlations of adipose organochlorine levels with age most likely reflects the fact that the older members of the study population have lived a greater proportion of their

lives during the era before *p,p'*-DDT and PCBs were banned from commercial use in the United States.

A serious weakness of this study, as with all case-control and prospective studies in which measurement of body burden is made at a single time, is that such a measurement may at best be regarded as a cross-sectional surrogate for a continuum of exposures that may have been experienced earlier in life. Over one's lifetime, body burden may increase because of continued exposure. The higher levels of OCCs measured in older women very likely reflect lengthier exposures that began prior to bans on manufacturing and/or usage, when environmental levels were much higher than at present. On the other hand, in the absence of continued exposure, body stores may be reduced over time as the compounds in question are metabolized and their products excreted, as well as by lactation (33). Our measurements provide no information about metabolic processes that may have been activated by past exposures. Nearly all epidemiological investigations published to date, including prospective studies, share these weaknesses. An additional weakness that has been pointed out in an Institute of Medicine report on health effects of the phenoxy herbicide Agent Orange may be termed the problem of false negatives. A low observed level of a metabolizable OCC may reflect either absence of exposure or the end stage of a higher level that has decayed over time (34). Case-control studies are more strongly affected by this source of false-negative measurements than are prospective studies, but in either type of study measurements made at a single time are inadequate to discriminate between these possibilities.

It was possible to test for an association between breast cancer risk and county of residence because both hospitals serve sections of New York City as well as the two Long Island counties. We found no important differences in OCC-related risk levels between Long Island and the adjacent county of Queens, whose breast cancer incidence ranks in the lower half of New York State counties (2).

The pattern of relative abundance of the individual analytes that belong to larger families of OCCs is often regarded as a "fingerprint" that may potentially convey information about sources of exposure or metabolism. As we have pointed out previously (28), the PCB congener profile (Table 2) is more typical of exposures of environmental origin than occupational. As is typical with case-control studies, few women in the present study were employed in occupations or industries with likely exposure to pesticides or PCBs.

The 1994 report by Dewailly *et al.* (10) of OCC-related increased risk in ER+ women has led many investigators to examine ER status. In the present study, when ER status was ignored the OR in the middle (but not the highest) tertile of total pesticide exposure was slightly elevated (1.27), but neither this nor any of the other ORs was statistically significant; the OR in this stratum (but in no others) became significant when calculations were restricted to ER– women; specifically, the ORs for the highest levels were not elevated. Our data therefore do not support the 1994 finding by Dewailly *et al.* (10).

This study did not attempt to assess either genetic factors by themselves or possible gene-environment interactions. A number of genetic factors such as mutations in the genes *BRCA1* and *BRCA2* are known to affect predisposition to breast cancer (35). Dunning *et al.* (36) recently summarized case-control studies that examined a wide variety of candidate genes for low-penetrance breast cancer susceptibility alleles and concluded that the maximum relative risk related to any of the polymorphisms *BRCA1*, *COMT*, *CYP17*, *CYP1A1*, *NAT1*, and *NAT2* was 1.5, whereas greater risks for *CYP2D6*, *GSTT1*, and



Table 5 ORs for breast cancer in Long Island, New York, 1994–1996, in relation to adipose DDE, total OCPs, and total PCBs by ER status<sup>a</sup>

Concentration in adipose tissue (ng/g)	ER+				ER–			
	Cases (n = 129)	Controls (n = 323)	Adjusted OR <sup>b</sup>	95% CI	Cases (n = 64)	Controls (n = 323)	Adjusted OR <sup>b</sup>	95% CI
DDE								
≤212.92	30	108	1.00		15	108	1.00	
212.93–618.81	42	108	1.06	0.58–1.92	31	108	1.63	0.80–3.35
>618.81	57	107	0.83	0.44–1.56	18	107	0.81	0.34–1.93
P-trend			0.5				0.9	
OCP <sup>c</sup>								
≤340.13	27	108	1.00		13	108	1.00	
340.14–878.14	48	108	1.21	0.61–2.06	35	108	2.17	1.03–4.58
>878.14	54	107	0.75	0.38–1.48	16	107	0.80	0.31–2.05
P-trend			0.3				0.8	
PCB <sup>c</sup>								
≤181.81	23	108	1.00		17	108	1.00	
181.82–332.24	40	108	1.20	0.65–2.21	24	108	1.29	0.63–2.65
>332.24	66	107	1.26	0.66–2.41	23	107	1.08	0.48–2.45
P-trend			0.4				0.9	

<sup>a</sup> Thirty-nine cases with either borderline or unknown ER status were excluded from analysis.

<sup>b</sup> Adjusted for age and BMI (continuous), hospital (two hospitals, indicator), race (white versus non-white, indicator).

<sup>c</sup> OCP, sum of seven organochlorine pesticide species; PCB, sum of 14 congeners; see text for details.

several others could not be excluded by existing data. Far fewer studies of gene-environment interactions in relation to breast cancer have been conducted, and several have produced conflicting results (37, 38). Ambrosone *et al.* (39) reported that breast cancer risk was unaffected by GSTM1 polymorphisms in women with either high or low dietary consumption of antioxidants. Moysich *et al.* (40) have reported an increased risk in postmenopausal breast cancer among women whose serum PCB levels were above the median and whose CYP1A1 genotype was either isoleucine:valine or valine:valine, relative to women with serum PCBs below the median and homozygous (Ile:Ile). Although this intriguing result needs to be followed up in other studies, it should be kept in mind that at least 8 of the 15 human CYP enzymes thus far characterized are polymorphic at the phenotypic or genotypic level, and it is quite likely that multiple CYP enzymes are involved in metabolizing human carcinogens (41).

There is emerging interest in identifying possible carcinogenic effects related to body burden of specific PCB congeners in humans. Three adipose tissue studies have reported associations of breast cancer risk with BZ 118 (10, 19, 42), whereas in a serum study (43) positive associations were “suggested” between serum levels of BZ 118 and BZ 138 and breast cancer risk. [In the study by Güttel *et al.* (42), no statistical adjustment for age was made despite the fact that the cases were considerably older than controls.] On the other hand, we found no significant association either with BZ 118 or BZ 138. Additional studies are needed to resolve these differences.

Most toxicological data on PCB congeners have been obtained in experimental studies [recently reviewed by Hansen (44)]. Seven of the congeners included in the present study of breast cancer in Long Island women were also among 18 tested by Connor *et al.* (45) for PB-like activity in induction of rat hepatic microsomal pentoxoresorufin *O*-dealkylase. Connor *et al.* (45) found BZ 187 to belong to the most potent group, with induction activity comparable with PB. A weaker group that included BZ 99, BZ 153, BZ 180, and BZ 183 induced pentoxoresorufin *O*-dealkylase activity at least 50% of the maximal response observed for PB. BZ 118 and BZ 170 were weak inducers. Of these seven congeners, only the concentration of BZ 183 differed significantly between cases and controls in our

study (Table 2). Thus, strength as a PB inducer did not predict mammary carcinogenicity in our population, and cases and controls differed little in the adipose concentration of most PB inducers. In fact, we found no association between breast cancer risk and 12 of the 14 measured congeners. A slight elevation was noted for the hexachlorinated congener BZ 156 that was statistically significant for the middle but not for the highest tertile. We noted a consistently elevated OR only for the heptachlorinated congener BZ 183, primarily in postmenopausal women; among such women with tissue concentrations >5.66 ng/g, OR was 3.2 (95% CI, 1.5–7.0). However, the more abundant di-ortho congener BZ 153, which makes up nearly one-fourth of total PCBs in humans (28), is a very strong PB-type inducer of cytochrome P-450 enzymes (44). It has also been reported recently to possess estrogenic properties (46). (There are no available reports on the estrogenicity of BZ 183.) The fact that neither the present study nor that of Aronson (19) observed an increased risk for BZ 153 makes it difficult to attach substantial biological significance to our elevated risk estimates for BZ 183 in the absence of replication in other populations or at least supportive mechanistic data.

Both estrogenic and antiestrogenic effects have been attributed to various PCBs based upon standard uterotrophic animal models (44). Nesaretnam *et al.* (47) have demonstrated that the non-ortho tetrachlorinated biphenyl BZ 77 can act as both an agonist and antagonist of estrogen action, and that this congener can enhance mammary carcinogenesis in the rat (48). Adipose levels of BZ 77 were reportedly associated with a 6-fold risk of breast cancer (OR, 5.8; 95% CI, 0.8–42) in a Swedish case-control study (49). This congener was not included in the panel investigated by Aronson (19) nor in the present study.

The large number of statistical tests that can be carried out in this database may produce a few statistically significant findings that have little or no biological meaning. As noted above, the proportions of cases and controls with nondetectable levels of analytes were significantly different for one pesticide and three PCB congeners, *i.e.*,  $\beta$ -HCH, BZ 167, BZ 178, and BZ 183; yet, the absolute case-control difference for  $\beta$ -HCH was <4% and for the PCBs was only 5–10%. Except for BZ 183 (which comprises <9% of the total PCB concentration),

the analytes that showed differences in detectability were not the same as those that showed significant case-control differences in mean levels. Furthermore, as shown in Table 2, the largest difference in the relative abundance pattern was for *p,p'*-DDE, whose mean did not significantly differ between cases and controls; no other differences exceeded 1.3% (BZ 74), and the majority of analytes differed by <1%. Judging the evidence as a whole, we conclude that the few observed case-control differences in detectability and mean analyte levels are not biologically meaningful.

Although the majority of epidemiological studies, including this one, have not confirmed these chemical compounds or related OCCs as likely causes of breast cancer, the fact that all samples tested to date have shown detectable levels of both pesticides (especially *p,p'*-DDE) and PCBs provides ample reason for concern about other possible health effects of these compounds, including cancers other than the breast. PCBs are classified by IARC as group 2A, "probably carcinogenic to humans," and *p,p'*-DDT is classified as group 2B, "possibly carcinogenic to humans" (50). Those classifications do not rely only upon epidemiological evidence but are based upon a multitude of additional considerations including carcinogenicity in animal bioassays and mechanistic considerations. The Agency for Toxic Substances and Disease Registry concluded in 1996 that "Studies in animals show that PCBs containing 60% chlorine by weight are clearly carcinogenic" (51). Systematic epidemiological studies of possible associations between OCCs and other types of cancer should continue to be undertaken.

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## Risk of Breast Cancer Classified by Joint Estrogen Receptor and Progesterone Receptor Status Among Women 20 to 44 Years of Age

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To gain insight into whether breast cancer tumors classified by their joint steroid receptor status (estrogen receptor (ER) and progesterone receptor (PR)) represent distinct diseases with differing etiologies, data from a population-based case-control study of women 20 to 44 years of age were analyzed. Cases included 1556 women diagnosed between 1990 and 1992. Age- and geographic-frequency matched controls included 1397 women identified by random digit dialing. Breast cancer risk factor information was obtained during a structured, in-person interview. Steroid receptor status was abstracted from medical records and from Surveillance, Epidemiology, and End Results (SEER) reports. Although relations between several other factors and the risk of ER-PR- tumors were in the opposite direction of those observed for ER+PR+ tumors, this heterogeneity was most pronounced for age, race and recreational exercise at 12-13 years of age. The multivariate-adjusted odds ratios (ORs) and 95% confidence intervals (CIs) among women with ER+PR+ tumors, were: 0.64 (0.47, 0.89) for 30-34 versus 40-44 years of age; 0.89 (0.63-1.25) for black versus white race; and 0.84 (0.68-1.03) for exercise at 12-13 years of age above the median versus at or below the median. The corresponding ORs and 95% CIs among women with ER-PR- tumors were: 1.24 (0.86-1.77), 1.51 (1.07-2.14), and 1.15 (0.90-1.48). Risk of ER-PR- cancer in relation to menstrual and reproductive (parity and lactation) characteristics, alcohol consumption, as well as family history of breast cancer were similar to those observed for ER+PR+ tumors. Associations between commonly identified breast cancer risk factors and ER+PR+ tumors were similar to those generally reported when hormone receptor status is not considered. In conclusion, these findings only modestly support the hypothesis that hormonally related risk factors have differing relationships with ER+PR+ versus ER-PR- breast cancer tumors among younger women.

Characteristics of pubertal development in a multi-racial/ethnic population of girls. \*JA. Britton, MS. Wolff, R. Lapinski, J. Forman, S. Hochman, G. Kabat, J. Godbold, S. Larson, G. Berkowitz (Mt Sinai School of Medicine, New York, NY 10029).

Early menarche increases future disease risk. Secular decline in age at menarche has been attributed to body size characteristics, diet, and physical activity. A cross-sectional study of 186 New York City area, nine-year-old-girls (54 African-American, 70 Hispanic, 62 Caucasians) was undertaken to explore such risk factors in relation to pubertal status. A questionnaire was interviewer-administered. Height and weight were measured. Pediatricians assessed pubertal development according to Tanner stages. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated by unconditional logistic regression. 35% of the Hispanics and 20% of the African-Americans had Caribbean maternal ancestry. African-Americans were more likely than Caucasians to be breast and hair pubertal (stage 2 or higher) (age-adjusted ORs and CIs = 4.91 (2.15-11.19) and 4.25 (1.85-9.77)). Pubertal development was similar for Hispanics and Caucasians. Adiposity and height were significantly, positively associated with being breast and hair pubertal. Vitamin C was inversely associated with hair development. The data suggested that more sedentary activity increased the likelihood of being hair pubertal and that lower caloric, but higher polyunsaturated fat, intake were positively associated with breast development. Body size results are consistent with the menarche literature. This study is among the few to have examined early pubertal development, and is the first to do so among African-American, Caucasian, and Hispanic girls. Additionally, the Caribbean maternal ancestry is a unique feature of our population.

## Occupation and breast cancer in women under 45 years of age

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Women currently comprise 46.5 percent of the employed workforce. With so many working women, it is important to consider occupational exposures as potential breast cancer risk factors. Therefore, the relation between breast cancer risk and job history among women 20 to 45 years of age who participated in a multi-center, population-based case-control study was examined.

Participants consisted of cases (N=1642), who were newly diagnosed with breast cancer in three geographic areas, and controls (N=1494), who were identified through random digit dialing procedures and who were frequency matched to the cases on 5-year age group and study site. Details about the three longest held jobs were collected and occupation codes were assigned by an industrial hygienist. Odds ratios (ORs) and corresponding 95% confidence intervals (CIs) were calculated using unconditional logistic regression and adjusted for age, study site, and other breast cancer risk factors. To estimate breast cancer risk associated with each occupation, women who had never held that job were considered as the reference group.

Only 0.9% of cases and 0.7% of controls reported never having been employed for at least six months. The distribution of reported occupations was similar for cases and controls; service and "marketing and sales" were the two most commonly held jobs. Among the occupations examined, only ever having been a teacher, librarian or counselor (TLC) was significantly associated with an increased breast cancer risk (Table 1). This increased risk was restricted to women who only held these jobs for fewer than 5 years or started working in these jobs 10 years or more prior to reference date. Breast cancer risk was not increased for women who ever held executive, administrative, or managerial positions (EAM) or for secretaries, stenographers or typists (SST).

Prior studies, although limited in power and involving effects of fairly low magnitude, have suggested alterations in risk for several occupations including teachers. The elevated risk among teachers has often been attributed to reproductive characteristics such as delayed or reduced childbirth. A strength of our study was the ability to adjust for these as well as a large number of other breast cancer risk factors making it unlikely that our findings are due to confounding.

**Table 1**

<b>Occupation</b>	<b>Adjusted OR</b>	<b>95% CI</b>
Ever TLC	1.26	1.00-1.58
TLC <5 years	1.57	1.12-2.20
TLC 10+ yrs prior to ref date	1.28	0.99-1.66
Ever EAM	0.94	0.77-1.13
Ever SST	1.14	0.93-1.40

# The Development of a Questionnaire to Assess Past Year Physical Activity in a Multi-ethnic/racial Urban Population

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## Summary

**Objectives:** Development of a questionnaire to assess past year physical activity energy expenditure (EE) at the baseline interview of a large multi-ethnic/racial prospective cohort study.

**Methods:** A 24-hour physical activity recall was administered to a convenience sample of 367 individuals from four New York City health agencies between October 1999 and February 2000. A particular physical activity's EE contribution to the population's activity EE was determined. This was repeated within subgroups (i.e., sex, study site, age) and at the individual level. Additionally, EE distributions were examined at the population, sub-group, and individual level.

**Results:** An approximately 30-minute interviewer-administered questionnaire was developed for the assessment of routine physical activity in a large scale study. Domain-specific (recreational, household, occupational, and transportation) physical activity EEs are ascertained. Included is the assessment of the amount (e.g., frequency and duration) of specific activities as well as those elicited by prompted open-ended questions. This information combined with published activity intensity levels is used to calculate summary measures of physical activity EE.

Although the types of physical activities identified from the 24-hour recalls were similar to those on existing questionnaires, sub-group and individual differences in EE were observed. Among men and women, median daily physical activity EE for those recruited at the Chinese and Puerto Rican sites was lower than those from the Caribbean or Dominican sites. No clear age related pattern was apparent for the percent of EE at any intensity level of activity. For both genders, a greater percentage of daily EE was spent in low versus high level intensity activities.

**Conclusion:** Capturing variation in EE levels requires information on type and amount of physical activity participation. Summary activity measures can be used to rank individuals analogous to nutrient measures obtained from food frequency questionnaires.



## Introduction

The epidemiologic evidence linking physical activity to a reduced risk of chronic diseases, such as coronary heart disease, osteoporosis, non-insulin-dependent diabetes mellitus, and several types of cancer is mounting<sup>1</sup>. Since physical activity is a modifiable behavior that can be incorporated into most individual's lifestyle, there is great interest in demonstrating that it is associated with a lower cancer risk. A protective effect for cancers of the breast and colon in relation to higher levels of physical activity has been fairly consistently observed<sup>2</sup>. Similarly, physical activity also appears to lower prostate cancer risk, but findings are less clear<sup>2</sup>. Fewer studies, with mixed findings have examined physical activity in relation to other cancers including endometrial, ovarian, testicular, and lung<sup>2</sup>. In general, studies have been conducted in non-Hispanic white populations and have focused on recreational or leisure-time physical activity, though some have also examined occupational activity. Therefore, additional research is necessary to explore whether the protective effect of physical activity on cancer risk extends to: cancers other than breast and colon, other physical activity types (e.g., household), and to other populations (e.g., African-Americans, Hispanics, Asians).

The New York Cancer Project (NYCP) is a prospective cohort study in the New York tri-state area (New York, New Jersey, and Connecticut) designed to examine the joint relationship of the environment, life-style habits, genetics, and cancer risk. Enrollment of men and women aged 30 to 69 years of age of different racial/ethnic backgrounds (black, Chinese, Caucasians, and Hispanics of Puerto Rican and Dominican descent) is currently underway. Given the large number of individuals targeted for enrollment the only practical means of measuring physical activity exposure is by questionnaire. With physical activity energy expenditure as a primary exposure of interest in the multi-ethnic/racial cohort, most existing questionnaires were inadequate for the cohort since, as mentioned above, they were designed to capture recreational and/or occupational physical activity energy expenditure in non-Hispanic white populations. Assessment of physical activity energy expenditure that does not take into account non-recreational physical activity may result in misclassification, particularly among women and in populations other than non-Hispanic whites<sup>3</sup>. Thus, a study was undertaken to develop a questionnaire that would assess household (including self and family care), occupational, transportation-related, and recreational physical activity energy expenditure for the cohort target population, which included both males and females of a wide age-range and of various races and ethnicities<sup>4</sup>. The aim was to capture physical activity energy expenditure for the one-year interval preceding interview.

This paper describes the database methods utilized for developing such a questionnaire. Similar methods, adapted from methodology established for developing food frequency questionnaires<sup>5</sup>, have been used to create an instrument to measure past seven-day activity among a Caucasian population in Switzerland<sup>6</sup>. The objective of the database approach is to identify the physical activities that contribute the most to absolute physical activity energy expenditure and that are the best discriminators of physical activity levels among persons. Finally, this paper describes how the questionnaire is structured as well as the questionnaire design considerations of counterbalancing participant burden with the ability to capture sufficient information to estimate physical activity energy expenditure.

## Methods

### *Study population*

To identify potentially relevant activities for inclusion in the questionnaire, 24-hour recall interviews were conducted. Interviewees consisted of a volunteer sample of men and women, primarily 30 to 64 years of age (subsequent to the completion of the interviewing for this developmental work the age eligibility of the cohort populations was extended to include those up to 69 years of age), and of various racial-ethnic groups. The participants were affiliated with several health agencies in New York City including Alianza Dominicana, Caribbean Women's Health Association, Chinatown Health Clinic, and the Puerto Rican Family Institute. In-person interviews, conducted in English, Spanish, and Chinese, took place from October 1999 to February 2000. Of the 396 24-hour physical activity recalls conducted, seven were unreliable and 16 were incomplete, leaving 373 interviews available for data analysis. The number of participants varied according to agency: Alianza Dominicana (9 men and 37 women), Caribbean Women's Health Association (45 men and 78 women), Chinatown Health Clinic (41 men and 73 women), and the Puerto Rican Family Institute (28 men and 56 women). For an additional 6 completed interviews, the participant's sex was not ascertained, and therefore these individuals are excluded from sex-specific data analyses (two at Caribbean Women's Health, three at Alianza, and one at Chinatown). The Mount Sinai institutional review board approved the protocol.

### *Data collection*

A structured questionnaire was administered by a trained interviewer. Participants provided information concerning all activities performed during the previous 24-hour period, beginning at the time they woke-up the day before the interview. The time of day the activity started and the length of time spent performing the activity were recorded. Additional information collected included the distance covered for activities such as walking, running, or biking and number of flights of stairs climbed. To obtain information on seasonal physical activities engaged in during other times of the year, subjects were also asked about activities that they often engaged in, specifically during warmer and colder seasons. For these seasonal activities, the number of days per week as well as the amount of time spent performing the activity were collected.

Questionnaire development also consisted of pilot testing drafts of the questionnaire on African-American, Chinese, Caucasian, and Hispanic individuals (10 in total) for comprehension, clarity, and administration time. During this process, the interviewer informally discussed the participants' interpretation of the questionnaire items. Questionnaire refinements based on the pilot testing experience are described below.

### *Data analysis*

**VARIABLE DEFINITION:** Health agency rather than self-identified race/ethnicity was used for analytic purposes so that we could examine if energy expenditure differed between Hispanics of different origins (i.e., Puerto Ricans versus Dominicans). This variable indicated whether a participant was Dominican, black, Chinese, or Puerto Rican. Approximately 10% of both males ( $n=14$ ) and females ( $n=30$ ) were unwilling to provide age information. These individuals along with those participants whose ages were just outside the cohort age range (three participants were  $< 30$  years of age and four were  $65+$  years of age) were excluded from the age-specific analyses. Due to the limited number of participants, particularly males, in the 50 to 64 years of age range, age was collapsed into the following five categories: 30-34, 35-39, 40-44, 45-49, and 50-64.

**CALCULATION OF DAILY PHYSICAL ACTIVITY ENERGY EXPENDITURE:** Reported activities were assigned a code from the compendium of physical activities developed by Ainsworth and colleagues that indicates the type and intensity (defined in metabolic equivalents (METs) as the ratio of activity metabolic rate to the resting metabolic rate) of the activity performed<sup>7</sup>. Activities not specified in the compendium were assigned the code of a similar activity. To ensure that coding remained uniform among coders, activities that required new codes were immediately added to the compendium.

For the data analysis it was necessary to have a complete record of a 24 hour period of physical activity for each participant. Since most participants reported approximately, but not exactly, 24 hours of activity, the duration of a person's activity time was adjusted to yield 1,440 minutes (or 24 hours) of total daily activity time. To do this, an inflation/deflation factor, defined as the ratio of 24 hours to the total duration of a participant's reported daily activities, was created. This value was then used to adjust each activity's duration accordingly. For instance, the adjustment factor for a participant who reported 1,200 minutes of daily activities was 1.16 (1,440/1,200).

Next, energy expenditure in kilocalories per hour (kcal/hr) associated with a given activity ( $EE_A$ ) for an individual was calculated using the following formula<sup>7</sup>:

$$EE_A = \frac{D \times M \times W}{60 \text{ minutes}}$$

Where,

D = Activity duration in minutes

M = Activity MET intensity in kilocalories·kilogram of bodyweight<sup>-1</sup>·hour<sup>-1</sup>

W = Bodyweight in kilograms

The  $EE_A$  was used to calculate the overall total daily physical activity energy expenditure on the following levels: (1) the total population level; (2) sub-group level, i.e. sex, study site, and age; and (3) individual level. Additionally, each activity's total energy expenditure, e.g. swimming, house cleaning, and eating, were determined for the population, sub-group, and individual level.

**ANALYSIS FOR SELECTION OF QUESTIONNAIRE ACTIVITIES:** To explore within-sex differences between age groups or study sites, the distribution of physical activity energy expenditure was examined. Statistical evaluation of variation among groups was performed using the Kruskal-Wallis test, a non-parametric test for comparing medians<sup>8</sup>. The contribution of a particular activity's energy expenditure to the population's physical activity energy expenditure was determined by calculating the percent of overall population daily energy expenditure it accounted for. These percent expenditures were ranked for each activity from highest to lowest according to their contribution to population-level physical activity energy expenditure. This procedure was repeated within subgroups to determine the percent of sex-specific, study site-specific, age-specific, and individual daily energy expenditure represented by each physical activity. To select the activities that contributed the most to absolute physical activity and were the best discriminators of physical activity levels among individuals<sup>6</sup> activities constituting 95% of the total, sex-specific, study site-specific, and age-specific population daily energy expenditure as well as any single activity accounting for 10% or more of a participant's daily physical activity energy expenditure were identified. Additionally, seasonal activities provided by the participants, but not identified in the structured data analyses, were added to the questionnaire. However, no specified criteria were used to select these.

### *Physical activities from other sources*

Due to time and budgetary constraints, recruitment efforts focused on racial/ethnic groups other than non-Hispanic whites since less physical activity information exists on these groups being recruited into the cohort. Thus, the activity list identified via data analysis was augmented with activities from additional sources including: a Swiss questionnaire developed using almost identical methodology<sup>6</sup>; a questionnaire designed to collect past year physical activity data in breast cancer survivors that was designed similarly to a food frequency questionnaire (Dr. Barbara Sternfeld, personal communication); the Minnesota leisure time questionnaire<sup>9</sup>; the Tecumseh occupational questionnaire<sup>10</sup>; and the Ainsworth physical activity compendium<sup>7</sup>.

## **Results**

### *Descriptive*

The median duration of sleep-time was eight hours and the average daily physical activity energy expended in the population was 2,913 kcal/day. As shown in table 1, men expended significantly more energy per day than women (median expenditure of 2937 kcal/day versus 2582 kcal/day for men and women, respectively). For both genders, the 50 to 64 year olds had lower median energy expenditure than those in the youngest age group, though the difference was statistically significant only for males (Wilcoxon p-values = 0.0009 and 0.3848 for males and females, respectively) (Appendix, Table A1 and A2). The only other age pair-wise comparisons of median energy expenditure that significantly differed from one another were also among men (30-34 year olds had greater expenditure than 35-39 and 50-64 years olds, while 40-44 year olds had lower expenditure than 45-49 year olds).

Overall, there was less variation in the median level of energy expenditure across the various age groups for women than for men (Appendix, Table A1 and A2). No clear age-related pattern was apparent for the percent of energy expended in any of the MET activity levels. For both genders, a greater percentage of daily energy expenditure was spent in low level activities (3-3.9 MET). The 90<sup>th</sup> percentile indicates that only a small proportion of individuals engage in 6+ MET level activities; women and men spent at most 3-11 and 7-28 percent of their respective total energy expenditure in 6+ MET level activities. The median number of hours spent sleeping ranged from one to two hours less for women than for men 40-64 years of age.

At each study site, men also expended more energy than women (Table 1). Among both men and women, the Chinese and Puerto Rican recruitment sites had similar median daily physical activity energy expenditure, which was lower than median daily energy expenditure observed for the Caribbean and the Dominican sites. However, the median daily energy expenditure for Dominican men versus either Puerto Rican or Chinese men was elevated, but did not reach statistical significance, yet the number of men in the groups provided only limited power to make such sub-group comparisons.

### *Selection of physical activities*

Table 2 presents the physical activities in the top 95% of the population, sex-, study site-, and age-specific analyses. Overall, participants' activities were characterized using 154 activity codes, of which 63 were required to account for 95% of the total population daily physical activity energy expenditure. The high number of activities necessary to reach 95% reflects the fact that most individual activities account for less than one percent of the population energy

expenditure. Common activities including daily living activities (sleeping, cooking or food preparation, eating, and showering) and sitting quietly accounted for the highest percentage of energy expenditure. Although the activities in the top 95% of the sex-, study site-, and age-specific energy expenditure predominantly reflected those in the combined population top 95%, 19 additional activities were identified (see shaded activities in Table 2). One (15040) was unique to gender, two (02065, 03021) were unique to study site, and four (01020, 03040, 05010, 05145) were unique to age, with the remaining activities identified in at least two group-specific analyses. Of these, 26.3% (5/19) involved household work and 15.8% (3/19) were occupational activities.

Examination of physical activities accounting for 10% or more of an individual's daily energy expenditure yielded 95 activity codes. Fourteen of these codes, displayed in table 3, were not identified in the population or group-specific analyses. In essence, participants reported the activities identified in the individual level analysis less frequently, yet for some participants these activities accounted for a significant amount of their daily physical activity energy expenditure. Tables 2 and 3 combined contain the physical activities that represent 95% of the population, sex-, site-, and age-specific energy expenditure as well as 10% or more of an individual's energy expenditure.

### *General questionnaire design*

The format of the questionnaire was adapted from the Minnesota Leisure-Time Physical Activity Questionnaire<sup>9</sup> (see questionnaire in Appendix). In general, participants are asked if they engaged in a specified activity during the previous 12 months. If so, the subject is queried about whether they performed the activity at least once a month during each of the past 12 months or in which months they engaged in the activity at least once a month. Finally, information is collected on the frequency (times per week) and duration (time per episode) of activity participation.

Activities are separated into major physical activity domains: recreation, household, occupation, and transportation which were then further subdivided e.g., household activity was divided into "activities associated with maintaining the inside of a house", "care-giving", "self-care", and "home maintenance and repair". Each major physical activity domain concludes with a prompted open-ended question that allows for the names and corresponding activity-related details of up to three other activities participated in during the previous 12 months.

Similar types of activities were grouped together to reduce the questionnaire length so that the administration time could be kept reasonable. Each activity or group of activities was assigned a MET level intensity using the compendium of physical activities<sup>7</sup>. Activities not listed in the compendium were given the MET value of a similar activity. For combined activities the MET value was assigned using the following hierarchal scheme: (1) the general compendium code; (2) the mean MET value of the activity codes listed in the combination; (3) the mean MET value of the most frequently engaged in subset of activities; or (4) the MET value of the most commonly participated in activity. When a "general compendium code" was unavailable, the second method was generally used. Methods three and four took precedence when it was noted that there was unequal participation in the activities comprising a group.

### *Questionnaire tailoring*

Optimizing the quality of the physical activity assessment must take into consideration both the amount of time necessary to complete the interview as well as the strain of having to recall very

detailed information. In accordance with our pilot testing experience as well as our review of the literature, questionnaire modifications were made to enhance the physical activity assessment. These modifications consisted of the following:

**OCCUPATION:** Job titles may not adequately reflect occupational energy expenditure, particularly if there is a large degree of variation in activity within a given job title. As a result, previous epidemiologic studies have inquired about occupational activities<sup>4,10</sup>. Information about actual job activities is thought to provide a better indication of occupational physical activity level, thereby allowing the energy expenditure of those holding the same job to be differentiated. Thus, for two of the occupation categories "office, research, or laboratory work including clerical or white-collar jobs" and "food, service, sales, or retail-related work" participants indicate how they spend 50% or more of their usual workday. Respondents select from: "sitting", "standing", "walking" "standing, walking, lifting, carrying, or pushing items weighing at least one pound but less than 25 pounds", "standing, walking, lifting, carrying, or pushing items weighing 25 pounds or more", or "other (specify)".

**SELF-CARE:** Self-care activities such as eating or sleeping are expected to be similar, on average, for any given day. Thus, these activities are assessed for a **usual** day in the previous year.

**WALKING:** Walking activities are inquired about separately for recreation and transportation and the MET value for is assigned based on a follow-up question about usual walking pace, which can be characterized as "slow", "moderate", or "brisk" by the participant.

**TRANSPORTATION:** New Yorkers use alternative (non-personal automobile) means of transportation more than individuals residing in other United States' geographic locations. Capturing transportation-related physical activity, which may be a more important source of physical activity in this population, is more complex in this population. Furthermore, similar to other populations, transportation activities differ for week versus weekend days. To capture this difference in a manner that is easy for respondents, the number of days per week that a given mode of transportation is used is collected. This question, along with the total duration per day for a given type of transportation, avoids confusion over whether a round-trip (i.e., going to and from a location) counts as one or two separate times.

**STAIRS:** Stair-related energy expenditure is based on flights of stairs ascended, since little energy is expended descending stairs. The stair-related question is similar to that used on other questionnaires<sup>10</sup>. Stair use is inquired about for a usual day, since like self-care activities, this activity is expected to be similar on most days of the year.

## Discussion

As a first step in the development of a physical activity questionnaire for use in the NYCP cohort, a study was conducted in a multi-racial/ethnic population (Hispanics of Puerto Rican and Dominican descent, Chinese, and blacks) to collect 24-hour physical activity information. The data collected, along with pre-existing physical activity information based primarily on non-Hispanic whites, were used to develop a physical activity questionnaire that will measure usual, overall and domain-specific (recreational, household, occupational, and transportation) physical activity energy-expenditure for the year preceding interview. Both the frequency, allowing for seasonal variation, and the duration of physical activities are also assessed with the new questionnaire. Activities not specifically listed on the instrument are captured by a prompted open-ended question asked at the conclusion of each physical activity domain section. Collected

information is used in conjunction with a pre-assigned MET level of intensity to determine summary measures of physical activity energy expenditure.

The questionnaire is designed to be interviewer-administered since the literacy of the proposed cohort population is not yet established. Pilot-testing administration took approximately 30 minutes. Currently, a computer-assisted interface is under development. The rationale for creating a computerized questionnaire includes shortening the administration time (i.e. skip patterns will be automated, "other, specify" responses will be easily recorded using look-up tables) as well as eliminating post-interview coding and data entry. The physical activity section is only one of many questionnaire components; thus a "streamlined" module to capture such exposure is critical for minimizing participant burden.

Although the 24-hour recall participants were comprised of a convenience sample, care was taken to ensure that the participants reflected the sex-, age-, and the race-ethnicity distribution of the targeted cohort members for whom less information on physical activity patterns existed. Furthermore, the 24-hour recall participants were selected from similar health facilities as the cohort members. The urban environment in New York City is distinct from most other regions of the United States, particularly with respect to the widespread use of public transportation and the minimal use of personal automobiles. Despite the use of a convenience sample, the physical activities selected from the 24-hour physical activity recalls were similar to those activities found on other questionnaires<sup>6,9,10</sup> and a questionnaire designed to collect past year physical activity data in breast cancer survivors (Dr. Barbara Sternfeld, personal communication). This, in conjunction with the supplementation of activities from items on other pre-existing questionnaires, indicates that the developed instrument may be appropriate for capturing physical activity energy expenditure in other populations.

Interestingly, group specific analyses (i.e., age, sex, or health agency) revealed only 19 activity codes not included in the top 95% of the total population daily physical activity energy expenditure codes. Identification of a list of activities that is common across sub-groups and/or individuals results in a questionnaire of reasonable length. Physical activities important at the subgroup or individual level can be obtained via an open-ended question. Despite the similarities in the types of activities, group/individual differences in total energy expenditure were observed. To capture this variation in energy expenditure levels it is critical to quantify the amount of participation in various activities.

Information on total daily physical activity energy expenditure is not widely available primarily due to the fact that non-recreational sources of energy expenditure are rarely assessed. Our observations that males as well as younger aged individuals expend more energy than women or older age individuals, respectively, were similar to those found in a population-based Swiss study of 425 men and 494 women<sup>6,11</sup>. Both our study and the Swiss study observed a fairly stable energy expenditure for women across age groups, while only the latter study found a fairly consistent decline in energy expenditure with age among men. Furthermore, unlike this other study, in which the percent of energy spent in 4+ basal metabolism rate activities decreased with age for both males and females, our data did not reveal any clear age-related patterns for any of the MET activity levels. Sleep patterns among women were similar however, U.S. men reported more hours of sleep than the Swiss men. Clearly, the smaller sample size in our study may not only have influence the precision of our estimates, particularly among men but also may account for a portion of the study finding differences.

In addition, we also noted variation in total energy expenditure by racial/ethnic group. To our knowledge, the lower energy expenditure observed among Chinese and Puerto Ricans when

compared to either Caribbean or Dominicans has not been previously reported. These data collectively suggest that total energy expenditure may not be consistent across population subgroups (e.g., sex, age, race/ethnicity). Observations on leisure time activity in the United States support this notion of subgroup variation in energy expenditure. Specifically, a higher prevalence of leisure time activity has been observed among: 1) males, particularly for activities in the high-intensity range; 2) younger adults; 3) more-educated individuals; and 4) whites<sup>12</sup>. Interestingly, these patterns of leisure time activity may not be consistent across the physical activity domains and as a result total energy expenditure patterns may also not reflect those of leisure time activity<sup>3</sup>. For instance, a study of women found that demographic characteristics are non-uniformly associated with the various physical activity domains<sup>13</sup>. For example, age was positively associated with household activity yet inversely associated with recreational activity, and lower education was positively associated with occupational activity but inversely associated with less recreational activity.

It is likely that both warm weather and weekend activities, potentially important contributors to energy expenditure, went undetected with the 24-hour recalls because they were conducted primarily on weekdays during cold weather months. In fact, the data we collected indicate the presence of seasonal variation in recreational and transportation-related activities. This observation is not surprising in light of the fact that considerable seasonal variation in physical activity has been observed in other studies<sup>14</sup>, including geographic locales with year-round warmer climates (Leslie Bernstein, personal communication). The infrequency of occupational and household activities as responses to the supplemental questions can be viewed as evidence that these activities are, in fact, less seasonally dependent. An alternative interpretation could be that the participants misunderstood the questions to be inquiring about recreational and transportation related activities only; no information is available to determine whether this occurred, however all interviewers underwent structured training on the administration of the questionnaire. To compensate for seasonal variation in activity, other established questionnaires were used to supplement the list of activities.

Intra-individual variability in physical activity makes it difficult to assess physical activity via questionnaire. Despite the flexible features (seasonal variation, frequency, duration, and prompted open-ended questions) of this newly designed questionnaire, it is more likely to capture routine rather than episodic patterns of activity. Thus, the physical activity energy expenditure calculated from the questionnaire is intended to represent the average, usual, energy expenditure rather than absolute energy expenditure. The purpose of this measure is to rank individuals so that they can be grouped into energy expenditure categories (e.g., quartiles) for the purpose of examining etiologic hypotheses in epidemiologic research. This is analogous to the primary use of nutrient measures obtained from a food frequency questionnaire<sup>15</sup>.

Based on research in other chronic diseases, it is believed that the physical activity operates via different pathways to influence disease risk. For instance, it has long been established that cardiovascular disease risk decreases with increased aerobic exercise<sup>12</sup>, whereas bone-loading activities are protective against osteoporosis<sup>12</sup>. A variety of biological mechanisms linking physical activity with cancer risk have been proposed and are discussed in detail elsewhere<sup>2</sup>. In brief, physical activity might alter cancer risk for a number of sites by influencing body mass, metabolic hormones, growth factors, hematologic factors and immune function. Site-specific mechanisms such as changes in bowel transit time and prostaglandin production have been proposed for colon cancer. Likewise, physical activity might alter breast cancer risk through its influence on menstrual characteristics that can modify sex hormone concentrations. The questionnaire was designed to allow for the joint consideration of different aspects (e.g., bone-loading versus aerobic exercise) and sources of physical activity energy expenditure to be



examined in relation to cancer outcomes. Furthermore, it is important that sedentary activity information is also collected so that it can be examined in relation to cancer risk given that physical inactivity has been linked to many other health problems such as cardiovascular disease<sup>12</sup>.

To our knowledge, the detailed physical activity energy expenditure information being ascertained in the NYCP has never been collected at baseline in a prospective cohort study. This comprehensive physical activity questionnaire will allow for in-depth investigations of the relation between physical activity and subsequent cancer incidence. With the emerging evidence that physical activity may reduce cancer risk at some sites, the public health importance of elucidating this relationship needs greater recognition since it provides a potential means for the primary prevention of cancer.

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In the conduct of research where humans are the subjects, the investigator(s) adhered to the policies regarding the protection of human subjects as prescribed by 45 CFR 46 and 32 CFR 219 (Protection of Human Subjects).

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Table 1. Average daily energy expenditure (kcal/day) assessed by 24-hour recall among 123 men and 244 women, by study site, New York City, 1999-2000<sup>1</sup>

Characteristic	Men						Women					
	Percentile						Percentile					
	No.	25 <sup>th</sup>	50 <sup>th,3</sup>	75 <sup>th</sup>	Mean	SD	No.	25 <sup>th</sup>	50 <sup>th,3</sup>	75 <sup>th</sup>	Mean	SD
Study site <sup>2,3</sup>												
Puerto Rican Family Institute	28	2404	2820 <sub>a</sub>	3528	3176	1306	56	2077	2383 <sub>c,d</sub>	2846	2522	800
Caribbean Women's Health Association	45	2873	3339 <sub>a,b</sub>	3757	3406	850	78	2541	3029 <sub>c,e</sub>	3809	3219	929
Alianza Dominicana	9	2415	3432	4980	3833	2047	37	2254	2790 <sub>d,f</sub>	3755	3150	1187
Chinatown Health Clinic	41	2173	2631 <sub>b</sub>	3115	2739	731	73	1991	2357 <sub>e,f</sub>	2603	2470	928
Total	123	2413	2937	3639	3162	1097	244	2146	2582	3188	2825	1004
												p-median = 0.0002

<sup>1</sup>The sex of the six individuals was not available therefore these individuals are excluded from the data presented in this table.<sup>2</sup>Values with the same letter subscripts indicate pair-wise comparisons that were statistically significant ( $p < 0.05$ ).<sup>3</sup>Values with the same symbol subscripts indicate pair-wise comparisons that are borderline significant ( $p = 0.05$ ).

Table 2. Physical activities accounting for 95% of the population daily energy expenditure among 373 participants, New York City, 1999-2000

Ainsworth code <sup>1</sup>	Description of physical activity <sup>2</sup>	% of population FF	Rank <sup>3</sup>											
			Population	Male	Female	Puerto Rican	Black	Dominican	Chinese	30-34 years	35-39 years	40-44 years	45-49 years	50-64 years
Description of physical activity <sup>2</sup>														
07029	Sleeping - not including napping	18.09	1	1	1	1	1	1	1	1	1	1	1	1
07020	Sitting quietly (riding in a car, listening to a lecture or music, watching television or a movie in a bus/plane/train/theater/church/at the beach, thinking, resting, praying at home)	7.46	2	2	2	2	3	2	2	2	2	2	2	2
05050	Cooking or food preparation-standing or sitting or in general (not broken into stand/walk components), making coffee	5.09	3	6	3	4	2	3	5	3	6	3	3	4
13030	Eating (sitting)/drinking/taking medications, eating and working	4.61	4	4	6	5	5	4	4	5	7	9	5	3
13050	Showering, towel drying (standing)	4.42	5	5	4	3	4	8	8	6	3	11	6	6
11580	Sitting/light office work, in general (chemistry lab work, light use of handtools, watch repair or micro-assembly, light assembly/repair, checking messages, computer work, closing up, getting ready to work, typing, examining patients)	3.84	6	9	5	7	15	6	3	4	5	5	9	10
16010	Automobile or light truck (not a semi) driving	3.47	7	3	15	6	6	11	15	7	4	4	10	17
17270	Walking, to work/class/elevator/train/bus/car/bank/home/to pick someone (not child) up	3.39	8	8	8	13	9	5	6	8	10	8	7	8
05030	Cleaning, house or cabin, office, general	2.95	9	29	7	15	7	7	12	15	11	12	4	5
11600	Standing: light (bartending, store clerk, assembling, filing, xeroxing, put up the Christmas tree, fixing computer, teaching)	2.78	10	7	11	8	11	35	7	11	8	18	16	7
13040	Sitting or standing-grooming (washing, shaving, brushing teeth, urinating, washing hands, putting on make-up, painting nails, fixing hair)	2.66	11	11	9	9	10	12	9	9	9	14	11	9
09055	Sitting-talking or talking on the phone	1.97	12	12	12	10	12	13	24	12	15	19	14	11
11610	Standing: light/moderate (assemble/repair heavy parts, welding, stocking, auto repair, pack boxes for moving, etc.), patient care (as in nursing)	1.77	13	10	14	12	8	-	44	13	-	6	21	22
05186	Child care: standing-dressing, bathing, grooming, feeding, occasional lifting of child, putting child to bed, waking child-light effort	1.72	14	30	10	29	13	10	17	10	14	13	34	19
13020	Dressing, undressing (standing or sitting), putting on coat, get things together to leave	1.66	15	13	13	11	14	21	26	14	18	17	15	14
17190	Walking, 3.0 mph, level, moderate pace, firm surface	1.32	16	16	19	24	24	26	18	29	21	20	29	16
07010	Lying quietly, reclining (watching television), lying quietly in bed-awake	1.26	17	22	17	20	16	18	38	19	19	23	25	21
11585	Sitting-meetings, general, and/or with talking involved, talking with patients, work at church	1.25	18	23	16	21	17	32	20	18	22	16	12	49
05020	Cleaning, heavy or major (e.g., wash car, wash windows, mop, clean garage, clean refrigerator), vigorous effort	1.14	19	14	35	-	20	9	30	16	35	37	26	25
05066	Walking-shopping (non-grocery shopping), running errands, window shopping	1.13	20	21	23	26	18	34	27	21	17	36	18	26
17130	Up stairs, using or climbing up ladder	1.09	21	18	24	19	36	24	19	20	25	35	23	38
05170	Sitting-playing with child(ren), reading to child, helping child with homework -light	1.04	22	38	18	-	19	15	33	17	12	40	27	-
17250	Walking, for pleasure, work break/coffee break, walking the dog, walking in museum, sightseeing, walking on beach/in park	1.03	23	20	27	17	22	33	23	25	27	42	8	27
07030	Sleeping - specifically napping	1.02	24	24	26	16	23	31	31	33	20	22	22	35
05052	Cooking or food preparation-walking	0.89	25	40	20	40	-	16	13	34	39	21	31	13
05041	Wash dishes-standing or in general (not broken into stand/walk components); cleaning dishes from table-walking	0.84	26	-	22	33	32	30	22	31	31	28	30	24
09030	Sitting-reading, book, newspaper, etc.	0.83	27	19	38	-	53	29	14	38	40	26	37	15
09010	Sitting, card playing, playing board games/ video games/computer, watch others play games	0.82	28	17	45	22	25	-	32	51	24	24	24	30
05040	Cleaning, light (dusting, straightening up, vacuuming, changing linen, carrying out trash, watering plants, feeding animals/fish), moderate effort (window seals)	0.79	29	46	25	27	21	-	35	48	42	-	13	20
05055	Putting away groceries (e.g., carrying groceries/supplies, shopping without a grocery cart, shopping cart unknown)	0.76	30	35	31	30	34	-	21	41	36	41	19	36
05185	Child care: sitting/kneeling-dressing, bathing, grooming, feeding, occasional lifting of child-light effort, patient care	0.75	31	-	21	-	27	22	29	47	33	34	33	23
11791	Walking on job, less than 2.0 mph (in office/store or lab area, inspecting something, going to meet someone), very slow	0.74	32	26	34	-	37	-	16	32	29	15	-	29
07040	Standing quietly (standing in a line, on a bus/train, in elevator, waiting for bus/train, looking out/in a window)	0.68	33	31	33	18	46	-	25	27	38	29	17	51
05187	Child care: picking up/taking children to day care/school/babysitter	0.62	34	41	32	42	28	25	-	23	34	25	-	-
11120	Construction, outside, remodeling	0.60	35	15	-	-	-	-	10	-	-	10	-	33
05060	Food shopping, with grocery cart	0.59	36	53	29	-	30	39	34	36	41	-	42	18
09050	Standing-talking or talking on the phone, partying, hanging out outside	0.58	37	34	40	23	45	40	40	43	37	33	28	-
17030	Carrying 74+ pound load, upstairs	0.58	38	-	28	-	-	-	11	-	-	7	-	-
05090	Implied standing-laundry, fold or hang clothes, put clothes in washer or dryer, packing suitcase	0.55	39	-	30	34	29	38	-	-	-	27	20	31
13035	Talking and eating/drinking or eating only (standing)	0.54	40	43	42	25	31	-	-	28	28	43	-	50
05095	Implied walking-putting away clothes, gathering clothes to pack, putting away laundry, looking for something (in the house), taking laundry downstairs to laundry room (laundromat)	0.51	41	44	41	41	50	23	42	49	-	-	32	37

Ainsworth code <sup>1</sup>	Description of physical activity <sup>2</sup>	% of population FF	Rank <sup>3</sup>											
			Population	Male	Female	Puerto Rican	Black	Dominican	Chinese	30-34 years	35-39 years	40-44 years	45-49 years	50-64 years
05051	Serving food, setting table-implied walking or standing	0.50	42	54	36	-	39	17	-	53	26	31	-	44
17160	Walking, 2.0 mph, level, slow pace, firm surface	0.45	43	33	52	31	40	-	51	40	45	-	38	43
17150	Walking, less than 2.0 mph, level ground, strolling, household walking, very slow	0.45	44	36	50	39	-	20	46	39	-	-	-	32
09040	Sitting-writing, desk work (paying bills, writing letter/card, reading mail, doing email)	0.42	45	45	47	28	-	-	39	37	-	-	39	47
05146	Standing-packing/unpacking boxes, occasional lifting of household items, light-moderate effort	0.42	46	-	39	-	26	-	-	24	-	-	41	-
01030	Bicycling, 12-13.9 mph, leisure, moderate effort	0.39	47	-	37	14	-	-	-	-	-	-	-	12
13010	Bathing (sitting)	0.38	48	-	43	32	-	27	53	54	-	30	-	52
09065	Sitting-in class, general, including note-taking or class discussion	0.35	49	-	44	-	38	-	49	-	-	38	35	-
09060	Sitting-studying, general, including reading and-or writing or doing homework	0.33	50	-	49	-	47	41	50	35	-	44	-	-
02030	Calisthenics, home exercise, light or moderate effort, general (example: back exercises), going up & down from floor), hoola hoop	0.32	51	-	46	-	-	28	37	-	-	-	36	39
11766	Truck driving, loading and unloading truck (standing)	0.30	52	25	-	-	44	-	48	-	13	-	-	-
16050	Driving heavy truck, tractor, bus	0.29	53	27	-	-	33	-	-	22	-	-	-	-
03025	Dancing, general	0.28	54	-	48	37	-	14	-	30	-	45	40	-
06140	Laying tile or linoleum	0.25	55	28	-	-	35	-	-	-	16	-	-	-
17070	Downstairs	0.25	56	52	-	44	-	-	-	-	44	-	-	-
17220	Walking, 4.0 mph, level, firm surface, very brisk	0.25	57	-	54	-	48	-	-	46	-	-	-	-
03030	Ballroom, fast (disco, folk, square)	0.25	58	-	51	-	52	-	43	-	32	-	-	28
07037	Waking up	0.25	59	-	-	-	-	-	45	-	-	-	-	41
05070	Ironing	0.23	60	-	-	-	51	-	-	57	-	-	-	-
11010	Bakery, general	0.23	61	32	-	-	-	-	28	26	-	-	-	-
17200	Walking, 3.5 mph, level, brisk, firm surface	0.22	62	-	-	-	-	37	-	45	-	-	-	-
17170	Walking, 2.5 mph, firm surface	0.21	63	-	53	-	-	19	-	55	-	39	-	-
01020	Bicycling, 10-11.9 mph, leisure, slow, light effort <sup>c</sup>	-	-	-	-	-	-	-	-	-	-	-	-	45
02020	Calisthenics (e.g., pushups, pullups, situps), heavy, vigorous effort	-	-	48	-	-	-	-	47	-	30	-	-	-
02065	Stair-treadmill ergometer, general <sup>b</sup>	-	-	-	-	-	-	43	-	-	-	-	-	-
03015	Aerobic, general	-	-	-	55	-	41	-	-	-	-	-	-	-
03021	Aerobic, high impact <sup>b</sup>	-	-	-	-	-	-	42	-	-	-	-	-	-
03040	Ballroom, slow (e.g., waltz, foxtrot, slow dancing) <sup>c</sup>	-	-	-	-	-	-	-	-	58	-	-	-	-
05010	Carpet sweeping, sweeping floors <sup>c</sup>	-	-	-	-	-	-	-	-	-	-	-	-	42
05080	Sitting, knitting, sewing, light wrapping (presents)	-	-	-	-	43	-	-	-	-	-	46	-	-
05145	Moving household items, carrying boxes <sup>c</sup>	-	-	-	-	-	-	-	-	-	-	-	-	48
05175	Walk/run-playing with child(ren)-moderate	-	-	-	-	-	-	-	36	52	-	-	-	46
06160	Painting, papering, plastering, scraping, inside house, hanging sheet rock, remodeling, hanging blinds	-	-	42	-	-	42	-	-	-	23	-	-	-
09020	Standing-drawing (writing), casino gambling, playing pool	-	-	-	-	-	49	-	-	-	-	-	-	40
10125	Guitar, rock and roll band (standing)	-	-	51	-	38	-	-	-	-	-	32	-	-
11720	Tailoring, cutting	-	-	-	-	-	-	-	41	42	-	-	-	-
11820	Walking or walk downstairs or standing, carrying objects 25-49 lbs	-	-	39	-	-	-	-	36	-	-	-	-	34
11830	Walking or walk downstairs or standing, carrying objects about 50-74 lbs	-	-	37	-	-	43	-	-	44	-	-	-	-
14020	Sexual activity, general, moderate effort	-	-	49	-	36	-	-	-	52	43	-	-	-
15040	Basketball, game <sup>a</sup>	-	-	47	-	-	-	-	-	-	-	-	-	-
15050	Basketball, nongame, general	-	-	50	-	35	-	-	-	50	-	-	-	-

<sup>1</sup>Italicized codes were newly developed codes for this study (see Methods, data collection).

<sup>2</sup>Boldface activities were activities reported by participants that were not listed elsewhere on the compendium of physical activities<sup>7</sup> (see Methods, data collection).

<sup>3</sup>Shaded boxes indicate physical activities that were not ranked in the top 95% of the total population daily energy expenditure.

<sup>a</sup>Activities unique to gender.

<sup>b</sup>Activities unique to study site.

<sup>c</sup>Activities unique to age.

Table 3. Physical activities accounting for 10% or more of an individual's daily energy expenditure that were not selected at the population, sex-specific, study site-, or age-specific level, among 373 participants, New York City, 1999-2000

Ainsworth code	Description of physical activity <sup>1</sup>
03020	Aerobic, low impact
05065	Standing-shopping (non-grocery shopping)
05147	Implied walking-putting away household items-moderate effort
05165	Walking-light, noncleaning (ready to leave, shut/lock doors, close windows, etc.), <b>turn on VCR, fixing small items</b>
07050	Recline-writing
09070	Standing-reading or smoking
11130	Electrical work, plumbing
11792	Walking on job, 3.0 mph, in office, moderate speed, not carrying anything
11795	Walking, 2.5 mph, slowly and carrying light objects less than 25 lbs
11850	Walking or walk downstairs or standing, carrying objects 100 lbs and above
17010	Backpacking, general
17025	Carrying load upstairs, general
17040	Climbing hills with 10- to 20-lb load
18240	Swimming laps, freestyle, slow, moderate or light effort

<sup>1</sup>Boldface activities were activities reported by participants that were not listed elsewhere on the compendium of physical activities<sup>1</sup> (see Methods, data collection).

TABLE A1. Physical activity in men (n =123), New York City, 1999-2000<sup>1,2</sup>.

	Age (years)	N	Percentile (P)					Mean	(SD)
			P10	P25	P50	P75	P90		
Total Energy Expenditure (kcal/day)	30-34	31	2379	2702	3432	3966	4980	3574	1241
	35-39	27	2170	2422	2914	3497	4132	3102	900
	40-44	13	2292	2503	3339	4725	5139	3532	1178
	45-49	11	2631	2723	2779	3162	3649	2971	601
	50-64	25	2073	2118	2667	3187	3639	2700	657
3 to 3.9 MET (%)	30-34	31	0	1	4	18	48	13	19
	35-39	27	0	0	3	8	11	5	8
	40-44	13	0	0	0	8	23	6	9
	45-49	11	1	3	6	13	29	10	10
	50-64	25	0	0	3	6	22	6	10
4 to 5.9 MET (%)	30-34	31	3	6	9	14	21	12	13
	35-39	27	0	4	8	19	32	13	15
	40-44	13	0	5	9	14	62	16	22
	45-49	11	0	0	7	9	19	7	7
	50-64	25	2	4	8	14	49	13	16
≥ 6 MET (%)	30-34	31	0	0	0	6	13	5	9
	35-39	27	0	0	0	6	28	6	11
	40-44	13	0	0	0	2	8	2	3
	45-49	11	0	0	0	3	7	2	4
	50-64	25	0	0	0	2	8	2	6
Sleep time (hours)	30-34	31	4	6	8	9	11	7	3
	35-39	27	6	7	8	10	11	8	3
	40-44	13	6	8	10	10	12	9	3
	45-49	11	5	6	9	10	10	8	2
	50-64	25	5	7	9	10	12	9	3

<sup>1</sup>The sex of the six individuals was not available therefore these individuals are excluded from the data presented in this table.

<sup>2</sup>Individuals that were <30 or >64 years of age and those for whom age information is missing are excluded from the data presented in this table.



TABLE A2. Physical activity in women (n =244), New York City, 1999-2000<sup>1,2</sup>.

	Age (years)	N	Percentile (P)					Mean	(SD)
			P10	P25	P50	P75	P90		
Total Energy	30-34	60	1818	2302	2676	3249	3814	2805	814
Expenditure	35-39	33	1911	2081	2486	2760	3136	2506	593
(kcal/day)	40-44	44	1988	2146	2473	3145	6159	2975	1483
	45-49	28	1968	2206	2660	3519	4207	2925	960
	50-64	44	1961	2131	2534	3543	4354	2874	1015
3 to 3.9 MET (%)	30-34	60	0	2	9	18	31	12	14
	35-39	33	0	0	5	17	26	10	11
	40-44	44	0	2	7	17	28	13	16
	45-49	28	0	2	6	20	40	13	15
	50-64	44	0	1	12	29	39	16	16
4 to 5.9 MET (%)	30-34	60	2	7	10	17	27	13	11
	35-39	33	3	6	9	14	22	11	8
	40-44	44	0	3	7	14	22	10	9
	45-49	28	0	4	9	16	25	11	9
	50-64	44	2	4	7	14	20	10	11
≥ 6 MET (%)	30-34	60	0	0	1	3	7	3	5
	35-39	33	0	0	0	3	7	2	4
	40-44	44	0	0	0	2	3	3	12
	45-49	28	0	0	1	3	9	3	5
	50-64	44	0	0	0	2	11	3	11
Sleep time (hours)	30-34	60	5	6	8	9	12	8	3
	35-39	33	7	7	9	11	15	9	3
	40-44	44	6	7	8	11	15	9	4
	45-49	28	5	8	8	10	11	8	2
	50-64	44	5	6	7	10	13	8	3

<sup>1</sup>The sex of the six individuals was not available therefore these individuals are excluded from the data presented in this table.

<sup>2</sup>Individuals that were <30 or >64 years of age and those for whom age information is missing are excluded from the data presented in this table.





Activity	Did you do this activity during the past 12 months?	How often did you do this activity during the past 12 months?	How long did you do this activity during the past 12 months?	How many times did you do this activity during the past 12 months?	How many hours did you do this activity during the past 12 months?	How many days did you do this activity during the past 12 months?	How many weeks did you do this activity during the past 12 months?	How many months did you do this activity during the past 12 months?	How many years did you do this activity during the past 12 months?	How many times did you do this activity during the past 12 months?	How many hours did you do this activity during the past 12 months?	How many days did you do this activity during the past 12 months?	How many weeks did you do this activity during the past 12 months?	How many months did you do this activity during the past 12 months?	How many years did you do this activity during the past 12 months?	How many times did you do this activity during the past 12 months?	How many hours did you do this activity during the past 12 months?	How many days did you do this activity during the past 12 months?	How many weeks did you do this activity during the past 12 months?	How many months did you do this activity during the past 12 months?	How many years did you do this activity during the past 12 months?
Were you employed during the past 12 months?																					
Perform office, research, or laboratory work including clerical or white-collar jobs																					
Perform food, service, sales, or retail-related work																					
Work in a dry cleaners, laundromat, linen service or other laundry-related industry																					
Do carpentry, locksmith, electrical, or plumbing-related work																					
Do construction, shoveling, outdoor remodeling, or masonry work																					
Do tailoring																					
Do housekeeping, janitorial, chambermaid, or other cleaning-related work																					
Teach in a school or other environment																					
Care for children as a job (do not include teaching previously reported)																					
Perform indoor decorating or remodeling activities, such as painting, wall-papering, or plastering																					
Cook or bake																					
Drive a car or light truck																					
Drive a heavy truck, tractor, or bus																					
Load or unload a truck																					
Participate in any other job or job-related activities? Remember to consider every job, part-time or full-time, paid or unpaid.																					
What is the name of this job-related activity that you participated in during the past 12 months (specify)?																					
What is the name of the next job-related activity that you participated in during the past 12 months (specify)?																					
What is the name of the next job-related activity that you participated in during the past 12 months (specify)?																					

If yes, continue with next row in occupation grid, else skip to transportation-related activities.

If yes, skip to prompted open-ended questions. Else, skip to transportation-related activities.



Activity	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Total	How often do you do this activity?	How long does it take you to do this activity?	How often do you do this activity?	How long does it take you to do this activity?
<p><b>Now, I am going to ask you about your household-related activities. This includes chores such as cleaning and cooking, as well as caregiving, self-care, and home maintenance or repair. We will start with activities associated with maintaining the inside of a house such as cleaning, laundry, grocery shopping, and cooking.</b></p> <p><b>Activities associated with maintaining the inside of a house (cleaning, laundry, grocery shopping, cooking)</b></p>												
Do laundry or ironing												
Grocery shop or put away groceries (do not include transporting groceries home)												
Prepare meals, including setting the table or serving food												
Clean-up from meals or wash dishes												
Do light cleaning, such as dusting, straightening up, pulling away things, sweeping, vacuuming, changing bed linens, carrying out trash, watering indoor plants, or cleaning sinks and counters												
Do heavy or major cleaning, such as washing windows or a car, mopping or scrubbing floors, or cleaning a garage												
<b>Caregiving</b>												
Care for elderly or disabled people												
Care for infants, toddlers, or children less than 6 years of age, including dressing, bathing, feeding, or holding												
Spend time with children while sitting or standing still, such as reading, helping with homework, or watching at the park												
Engage in active play with children that involved movement, such as walking or running												
<p><b>Now, I am going to ask you about a few self-care activities. I am interested in knowing about how long, on average, you did each of these activities on a typical day over the past 12 months.</b></p> <p><b>Self-care (bathing, grooming, and eating)</b></p>												
Eating meals and snacks												
Grooming, including showering or bathing, dressing or undressing, shaving, brushing teeth, pulling on make-up, or fixing hair												
Napping or resting awake in bed, while not doing other activities												
Time go to sleep												
<p><b>Time wake-up or finish sleeping</b></p> <p><b>Home maintenance and repair (including indoor and outdoor projects, yard-work, and snow removal)</b></p>												
Perform indoor decorating or remodeling activities, such as painting, wall-papering, or plastering												
Participate in any other household-related activities? Do not forget activities such as home repair projects, yard-work, or snow removal.												
What is the name of the first household-related activity that you participated in during the past 12 months (specify)?												
What is the name of the next household-related activity that you participated in during the past 12 months (specify)?												
What is the name of the next household-related activity that you participated in during the past 12 months (specify)?												
What is the name of the next household-related activity that you participated in during the past 12 months (specify)?												

If yes, skip to prompted open-ended questions. Else, skip to occupation-related activities.

During the past 12 months, what time, on average, did you wake-up or finish sleeping? Again, do not worry if your wake-up time differs between week and weekend days, just tell me the time that applies to the majority of the days.

During the past 12 months, what time, on average, did you go to bed? Do not worry if your bed time differs between week and weekend days, just tell me the time that applies to the majority of the days.

During a usual day over the past 12 months, how long, on average, did you spend napping or resting awake in bed?

During a usual day over the past 12 months, how long, on average, did you spend eating, including meals and snacks?

During a usual day over the past 12 months, how long, on average, did you spend grooming, including showering or bathing, dressing or undressing, shaving, brushing teeth, pulling on make-up or fixing hair?



**CHARACTERISTICS OF PUBERTAL DEVELOPMENT IN A MULTI-  
RACIAL/ETHNIC POPULATION OF NINE-YEAR OLD GIRLS**

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## **Abstract**

**Purpose:** Early age at menarche increases future disease risk. Secular decline in age at menarche has been attributed to body size characteristics, diet, and energy expenditure. Risk factors for pubertal onset have been less frequently explored.

**Methods:** A cross-sectional study of 186 New York Metropolitan Area, nine-year-old-girls (54 African-American, 70 Hispanic, 62 Caucasians) used interviewer-administered questionnaires to assess exposures. Height and weight were measured. Pediatricians assessed pubertal development according to Tanner stages.

**Results:** African-Americans were more likely than Caucasians to be breast and hair pubertal (stage 2 or higher) (age-adjusted odds ratios and 95% confidence intervals = 4.91 (2.15-11.19) and 4.25 (1.85-9.77)). Pubertal development was similar among Hispanics and Caucasians. Adiposity and height were significantly positively associated with breast or hair development. More sedentary activity hours were associated with a higher likelihood of being hair pubertal. Lower energy, but higher polyunsaturated fat, consumption was weakly associated with breast development. An inverse relationship existed between vitamin C and hair development. No other nutrients or physical activity measures were related to pubertal development.

**Conclusions:** Results are consistent with height and adiposity being associated with pubertal development. Sedentary activity or diet may also influence maturation.

**MeSH heading key words:** puberty, body size characteristics, physical activity, diet, cross-sectional, menarche, adolescence

**Abbreviations:** wt/ht, weight divided by height; BMI, body mass index (weight in kilograms divided by height in meters squared); kg, kilograms; YAQ, Youth/Adolescent Food Frequency Questionnaire; MET, metabolic equivalent; kcal/wk, kilocalories per week; ORs odds ratios; CIs 95% confidence intervals; aOR age-adjusted odds ratio;

Puberty begins approximately three years before menarche, when secondary sexual characteristics appear. Pubertal onset is modestly correlated with age at menarche (1, 2). Early maturation has been linked to adverse health outcomes including insulin resistance, breast cancer, and cardiovascular disease (3, 4). Age at menarche varies by geography (5), has declined secularly (6), and differs by race/ethnicity (7). Similar trends may exist for age of pubertal onset, though not been well documented (8). A recent study of over 17,000 U.S. girls found that African-American girls began menses approximately 8.5 months earlier than white girls; breast and hair pubertal development began on average 1 and 1.5 years, respectively, earlier in African-American girls (7). Mexican-American girls are believed to have similar or slightly later reproductive development than Caucasian girls (9). Yet little published information on maturation in other U.S. Hispanics is available. As reproductive characteristics such as birthweight differ among Hispanic subgroups, it is plausible that reproductive development also varies (10).

Acknowledged disparities in the age at menarche imply that environmental factors influence the rate of reproductive development, but the determinants of earlier maturation are unclear. Adiposity has been consistently, positively associated with onset of menses (11-13). Other factors, including height, diet, and physical activity, have also been linked with menarche, though less consistently (14-18). Whether these characteristics affect pubertal development is unknown (13, 15, 19). We undertook a study of African-American, Hispanics, and Caucasian girls to examine pubertal development in relation to body size, physical activity, and diet.

## **Methods**

A cross-sectional study was undertaken in New York City from Spring 1997 to Fall 1998. Nine-year-old-girls of African-American, Hispanic, or Caucasian race/ethnicity, visiting the Mount Sinai Hospital Pediatric Clinic or a nearby pediatric private practice for a wellness visit

were eligible. Girls with existing endocrine disorders were ineligible. Of 224 girls invited to participate, 200 (89%) were eligible, agreed to do so, and had either parental or guardian signed, informed consent. Refusal ( $n = 20$ ) was the primary reason for non-participation. The Mount Sinai Institutional Review Board approved the study protocol.

#### *Classification of Pubertal Development*

Girls and their pediatricians assessed the stages of breast and pubic hair development, using standardized drawings and descriptions based on Tanner criteria (provided by Professor Richard Udry, Carolina Population Center, Chapel Hill, NC) (20). These two assessments on a subset ( $n=20$ ) were poorly correlated; thus, the physicians' classification of puberty stage was utilized. Girls were considered prepubertal (stage 1) or pubertal (stages 2-5) for breast and pubic hair development.

#### *Body Size Characteristics*

Pediatric nurses measured height and weight. Weight in kilograms (kg), weight/height (wt/ht), body mass index (BMI; weight (kg)/height in meters squared), and a standardized index of BMI were used to explore the relationship between adiposity and pubertal development. Wt/ht rather than BMI may be a better measurement of childhood obesity (21). BMI is presented to allow for comparison with other published findings. The standardized BMI index (normal, obese, and very obese) was based on the cutpoints 20.51 and 22.40, corresponding to the 85<sup>th</sup> and 95<sup>th</sup> BMI percentiles of the National Health and Nutrition Examination Surveys I and II (mean BMI 17.3 and standard deviation 3.1 for nine-year old girls) (22-25).

#### *Dietary Intake*

Interviewers administered the Youth/Adolescent Food Frequency Questionnaire (YAQ) to assess usual diet in the year preceding interview (26). Average daily nutrient intakes of

macronutrients and selected micronutrients (crude fiber, folate, retinol, carotene, and vitamins A, C, D, and E) were calculated.

### *Physical Activity*

Participation in pre-specified activities (hours per week) were grouped according to intensity level or metabolic equivalent (MET) scores (27). One MET is equivalent to the oxygen consumption at rest (~1 kilocalorie/kilogram/hour (kcal/kg/hr)). Adult norms were used because to our knowledge none exist for children. Activities were grouped as follows: sedentary ("jacks, quiet games", "cards, board games", "television/videos/movies", "computer games"); moderate ("walking/hiking"); and vigorous ("jogging/running/track", "soccer/softball/basketball", "swimming/aerobics", "gymnastics/dance class", "bicycling/tennis/skiing"). Other activities were assigned in a similar fashion.

Sedentary activity and moderate, vigorous, and total (moderate plus vigorous) physical activity were considered separately. Non-sedentary activity was examined as kcal/wk, as individuals of differing body weights expend different amounts of energy for the same quantity of activity. Total kcal/wk of activity was calculated as follows (27):

$$total\ kcal/wk_{activity} = [(I_{moderate} \times H_{moderate}) + (I_{vigorous} \times H_{vigorous})] \times Wt$$

where,

H = Hours of activity per week

I = Average MET score by category; moderate (4 kcal / kg · hr), vigorous (7 kcal / kg · hr)

Wt = Body weight in kgs

### *Other Measures*

Race/ethnicity, medical history, birth information, maternal birthplace and education were also collected. Maternal education, less than 12 years versus 12 or more years, was used as a proxy for socioeconomic status. Girls self-identified race/ethnicity as African-American,

Hispanic or Caucasian. Those reporting both African-American and Hispanic ( $n = 3$ ) were considered African-American (7).

### *Statistical Analysis*

To examine demographic characteristics by pubertal status the Wilcoxon rank-sum (28) and the Mantel-Haenszel chi-square tests were used (29). Unconditional logistic regression was used to determine odds ratios (ORs) and 95% confidence intervals (CIs) (30, 31). Models included age (continuous) and the indicator variable race/ethnicity (Hispanic/African-American/Caucasian). Because height and wt/ht slightly altered risk estimates, the adjusted models are presented. The standard multivariate and residual nutrient methods yielded similar results; hence the models that adjust for caloric intake (continuous) are presented (21). Continuous variables were tertiled based on the entire study population distribution and were entered as indicator variables. To assess linear trend, indicator variable scores were entered as ordinal. Subgroup analyses were not performed due to the small sample size.

Of the 192 girls with pubertal staging, six were missing body size information. The study population presented consists of 186 girls with pubertal staging, physical activity, and body size data. Girls without dietary information ( $n = 14$ ) were included in the non-dietary analyses as excluding these girls did not materially change estimates. Exclusion of 13 girls whose daily caloric intake was greater than 5,000 kcal (none reported less than 500 kcal) did not alter dietary results; therefore data from the larger group are presented (26).

### **Results**

The distribution of demographic characteristics by pubertal status is presented in Table 1. More girls were considered pubertal for breast (52%) than for pubic hair development (32%). Pubertal girls were slightly older and their mothers were less educated than prepubertal girls. Of 186 girls, 54 were African-American, 70 were Hispanic, and 62 were Caucasians. Among

mothers of Hispanic girls, one-quarter were born in Puerto Rico while 10% were born in the Dominican Republic (data not shown). Almost 20% of the African-American mothers were born in the Caribbean Islands. Maternal education was strongly associated with race/ethnicity (data not shown:  $\chi^2_{p\text{-value}} < 0.0001$ ); therefore only race/ethnicity was considered in subsequent analyses.

Racial/ethnic differences in pubertal status (Table 1) were also clearly seen in the multivariate analyses (Table 2). African-American girls were more likely to be breast (age-adjusted odds ratio (aOR) and CI = 4.91 (2.15-11.19)) or hair (aOR and CI = 4.25 (1.85-9.77)) pubertal than Caucasian girls, whereas development was similar for Hispanics and Caucasian girls (Hispanic versus Caucasian aORs and CIs = 1.14 (0.57-2.29) and 1.61 (0.70-3.68) for breast and hair, respectively). African-American girls were slightly older and taller than the other girls, yet median weight and wt/ht were highest among Hispanic girls (all p-values > 0.05) (data not shown). Nearly a quarter of the African-American and Hispanic girls, but only one-tenth of the Caucasian girls, were classified as very obese using the standardized index of BMI (data not shown).

As shown in Table 3, pubertal girls were taller, heavier, and had higher wt/ht than pre-pubertal girls for both breast and pubic hair development. Age- and race/ethnicity-adjusted ORs and 95% CIs for breast pubertal stage were 6.43 (2.75-15.02) and 4.55 (1.93-10.71) for highest versus lowest tertile of wt/ht and of height, respectively. The corresponding wt/ht and height ORs and 95% CIs for hair puberty were 3.57 (1.53-8.35) and 5.81 (2.34-14.33). Weight risk estimates were similar to those for wt/ht. Simultaneous consideration of height and wt/ht attenuated the estimates, yet each remained independently related to breast pubertal status (data not shown); however, wt/ht was no longer significantly associated with hair pubertal stage.

Obese and very obese girls were more likely to be breast-pubertal, whereas only very obese girls were at greater risk of being hair pubertal.

Pubertal development was similar for girls who engaged in higher versus lower levels of total physical activity (Table 4); the upper versus lowest tertile of total physical activity adjusted-ORs and CIs were 0.89 (0.39-2.02) and 1.04 (0.45-2.40), for breast and hair, respectively. There was no evidence of an inverse trend. Separately considered, neither vigorous nor moderate activity was associated with pubertal development (data not shown). Girls engaging in more sedentary activity may be at increased risk of being hair pubertal (adjusted OR and CI for the upper versus lower tertile of sedentary activity hours = 1.96 (0.78-4.94)); risk increased, non-significantly, for each successive tertile of sedentary activity. Further adjustment for total physical activity did not materially alter risk estimates (data not shown). Sedentary activity was not associated with breast development.

Dietary associations are displayed in Table 5. Girls in the upper two tertiles of total caloric intake had a lower risk of being breast pubertal than the reference group. This inverse trend was only borderline significant. There was a suggestion that higher polyunsaturated fat consumption increased the risk of breast development (p-trend = 0.05). No other macronutrients were related to pubertal development. Of the micronutrients, there was a strong inverse association between vitamin C and the risk of being hair pubertal ((adjusted OR and 95 percent CI for the highest tertile of intake = 0.20 (0.07-0.63); p-trend = <0.01). Higher intakes of several other micronutrients may lower the risk of being breast or hair pubertal, yet many of these estimates were unstable with no clear dose-response.

## **Discussion**

Our study is among few that have examined early pubertal development, and is the first to do so among African-American, Caucasian, and Hispanic girls. A large percent of our



population had Caribbean maternal ancestry, another unique feature of our study. Indeed, the percent of our girls with ancestry in the Caribbean Islands may even be larger, because information on the father's and grandparent's birthplace was not collected. Advanced breast and hair pubertal status was more common among older girls as well as among African-American girls, but was similar among Hispanic and Caucasian girls. Additionally, girls who were taller, heavier, or had a greater ht/wt ratio were at higher risk of being breast and hair pubertal. Girls engaging in more hours of sedentary activity had an elevated, but non-significant, risk of hair development, yet the data did not support a relation between the other physical activity measures and pubertal development. Our results suggest a possible relation between some dietary factors and pubertal status. Risk of being breast pubertal was greater among girls with higher intakes of polyunsaturated fat and among those with lower total caloric intake. In contrast, higher vitamin C consumption decreased the risk of hair development.

Advanced pubertal development among African-American girls relative to Caucasian girls agrees with previous studies (7, 32). The differences remained following adjustment for age, height, wt/ht, calories, and polyunsaturated fat (breast only) or vitamin C (hair only), suggesting that genetic or other environmental factors should be considered (33). Whereas we noted similar pubertal status among Caucasian and Hispanic girls, a prospective study in California observed a similar age at menarche for African-American and Hispanic girls which was earlier than the age at menarche for Non-Hispanic Caucasians (34). Although not specified, the Hispanic girls in California are presumably of Mexican descent, while ours were predominantly of Caribbean descent. Reproductive development may differ among Hispanic subgroups. It is also possible that risk factors for the onset of puberty and menarche differ because the ages at onset of these two events are strongly, but not perfectly, correlated (35).

The hypothesis that a critical body weight or fatness is required to trigger menarche has not been confirmed (36). But our study, other cross-sectional studies of puberty (13, 32), and several prospective studies of menarche (18, 34, 37-40) have observed a link between body size characteristics and maturation. Since body fat accumulation occurs around the time of puberty it is difficult to disentangle pre- from post-pubertal changes even in prospective studies. Post-pubertal body size changes would result in an overestimation of the body size characteristic-pubertal status associations in our study. Our limited sample size precluded the re-examination of the previously reported finding that the relationship between BMI and breast development was stronger among Caucasian versus African-American girls (13).

The influence of diet on maturation is suggested by the delayed menses observed in undernourished and anorexic girls (41, 42). Most observational studies (37, 38), including a longitudinal study of over 2,000 Canadian girls (17), and several other prospective studies (34, 39, 40) do not provide consistent evidence linking specific nutrients to age at menarche. For example, in contrast to our findings, others report delayed menarche in relation to higher polyunsaturated fat consumption (43) and to lower vitamin C intakes (38). Although not all studies agree (17, 38), weak associations such as those we noted between some micronutrients and pubertal status agree with reports that menarche occurs later in vegetarian girls (15) and among girls with higher fiber intakes (44). Finally, an inverse association between breast pubertal stage and caloric intake agrees with the findings of two prospective studies of menarche (34, 38). The association may be partially that overweight girls underreport their dietary intake (34). Indeed, when heavier girls were excluded from the analyses, similar to Koprowski et al., our inverse association was less pronounced (34).

Anthropometric characteristics, physical activity, and diet are strongly intertwined. When intake exceeds expenditure over an extended period, body weight and body fat increase

(45). Despite some evidence that diet and physical activity are independently associated with maturation, it is also possible that they operate through their impact on anthropometric characteristics. If anthropometric variables mediate the relationship, adjustment for body size characteristics might obscure the underlying association. ORs were similar with and without adjustment for anthropometric characteristics suggesting that at least some portion of the influence of physical activity and dietary intake on pubertal development is independent of their effects on body size characteristics. Evidence that physical activity may operate partially independent of body size comes from a prospective study of 15 ballet dancers. Menarche occurred in two-thirds of the girls during a hiatus from dancing, although their body composition and weight remained fairly stable (46). This and other evidence suggest that gonadotropin secretion, which is thought to be critical in pubertal onset, may be suppressed during extreme energy deficits (19).

Delayed menarche and amenorrhea have been associated with prolonged vigorous or moderate physical activity (16, 18, 39, 40, 47, 48), although not all studies support such an association (33, 38). With the exception of an increased risk of hair development among more sedentary girls, our physical activity results were essentially null. In accordance with our finding, a previous study reported an earlier menarche among girls spending more time in sedentary activities (43).

Study strengths include the outcome and exposure assessments. Pediatrician assessment of pubertal staging was used. Inter-rater reliability between two pediatricians of pubertal staging for 20 girls (kappa 0.78 for breast and 0.69 for pubic hair) was similar to or better than that previously reported (49). Trained nurses measured body size characteristics. The questionnaire included physical activities of varying intensities as well as an open-ended question capturing less common activities. The YAQ had a one year reproducibility among 9-18 year olds that was

comparable to that of other adolescent dietary questionnaires and was unrelated to age or ethnicity (26). Furthermore, our nutrient values, though slightly higher, were consistent with other reports of girls this age (26). The use of tertiles, or ranks, for categorizing exposures reduces misclassification. Even if exposures were adequately measured, it is possible that exposures earlier in life are more relevant to pubertal onset than the time-frame of our exposure assessment.

Study limitations include the cross-sectional design which precludes examining the temporal sequence between exposures and pubertal development. Post-pubertal changes in exposures may bias estimates. For instance, girls progressing through puberty may become self-conscious about their bodies, thereby possibly reducing dietary intake or increasing physical activity. Reporting of post-pubertal behavior would bias dietary associations toward, but physical activity associations away from, the null. Race/ethnic-specific attitudes toward these behaviors would yield estimates that were biased differently between the groups.

Maternal education and access to care provide some information on socioeconomic characteristics. This information was limited and could not be distinguished from race/ethnicity. Yet, despite their similarities in the socioeconomic characteristics, African-American and Hispanic girls differed in their pubertal status suggesting that other environmental or genetic characteristics may be instrumental in pubertal development.

Consistent with previous studies, our strongest findings indicate positive associations between pubertal development and adiposity measures as well as height. The links we observed between pubertal development and dietary intake, notably caloric intake, polyunsaturated fat, and vitamin C, should be weighed against the instability of the risk estimates. In addition to the multiple dietary comparisons made, results of previous studies, including several prospective studies of menarche, did not agree with our results, further indicating the tenuous nature of our

dietary findings. Difficulties in assessing diet may hamper the ability of all studies to detect such associations. Finally, the notion that girls engaging in more physical activity have delayed maturation is not supported by our results, although physical activity in our sample was clearly not as strenuous as that of ballet dancers (16, 46). We had limited power to detect small associations and to explore racial/ethnic differences. Future longitudinal studies with larger numbers of multi-racial/ethnic girls can expand our work. Given the link between early puberty and/or menarche and disease risk later in life, elucidation of environmental or lifestyle factors influencing maturation may offer young girls the ability to reduce subsequent disease burden.

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Table 1. Baseline characteristics by pubertal status among 186 girls in New York City, 1997-1998

	Breast		Hair	
	Pre-Pubertal (No. = 89)	Pubertal (No. = 97) p-value	Pre-Pubertal (No. = 127)	Pubertal (No. = 59) p-value
Age (years, median) <sup>1</sup>	9.42	9.57 0.02	9.46	9.61 0.03
Maternal education (years, median) <sup>1</sup>	15	12 <0.01	14	12 0.04
Race				
African-American	12 22%	42 78%	26 48%	28 52%
Hispanic	40 57%	30 43%	51 73%	19 27%
Caucasian	37 60%	25 40% <0.01 <sup>2</sup>	50 81%	12 19% <0.01 <sup>2</sup>

<sup>1</sup>Median values compared using the Wilcoxon rank-sum test.

<sup>2</sup>Mantel-Haenszel chi-square test.

Table 2. Age adjusted odds ratios (aORs) and 95% confidence intervals (CIs) for breast and hair pubertal status associated with race/ethnicity, among 186 girls in New York City, 1997-1998

Race/Ethnicity	Breast				Hair			
	Pre-pubertal		Pubertal		Pre-pubertal		Pubertal	
	No.		No.		No.		No.	
	89	97	aOR	95% CI	127	59	aOR	95% CI
Caucasian	37	25	<b>1.00</b>		50	12	<b>1.00</b>	
African-American	12	42	<b>4.91</b>	2.15 - 11.19	26	28	<b>4.25</b>	1.85 - 9.77
Hispanic	40	30	<b>1.14</b>	0.57 - 2.29	51	19	<b>1.61</b>	0.70 - 3.68

Table 3. Age and race/ethnicity adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for breast and hair pubertal status associated with anthropometric characteristics, among 186 girls in New York City, 1997-1998

	Breast				Hair			
	Pre-pubertal		OR	95% CI	Pre-pubertal		OR	95% CI
	No.	No.			No.	No.		
	89	97			127	59		
BMI (kg/m <sup>2</sup> )								
< 16	40	22	<b>1.00</b>		48	14	<b>1.00</b>	
16-19	31	31	<b>2.15</b>	0.98 - 4.71	45	17	<b>1.46</b>	0.62 - 3.43
> 19	18	44	<b>5.13</b>	2.24 - 11.74	34	28	<b>2.78</b>	1.22 - 6.33
p-trend <sup>1</sup>			<0.01				0.01	
Height (in)								
< 53	39	18	<b>1.00</b>		47	10	<b>1.00</b>	
53-55	32	36	<b>2.70</b>	1.22 - 5.97	55	13	<b>1.10</b>	0.43 - 2.83
> 55	18	43	<b>4.55</b>	1.93 - 10.71	25	36	<b>5.81</b>	2.35 - 14.33
p-trend			<0.01				<0.01	
Weight (kg)								
< 30	41	21	<b>1.00</b>		49	13	<b>1.00</b>	
30-37	33	28	<b>2.09</b>	0.95 - 4.63	47	14	<b>1.26</b>	0.52 - 3.06
> 37	15	48	<b>6.96</b>	2.93 - 16.52	31	32	<b>3.58</b>	1.56 - 8.25
p-trend			<0.01				<0.01	
Weight/height								
< 57	41	21	<b>1.00</b>		50	12	<b>1.00</b>	
57-67	32	30	<b>2.22</b>	1.01 - 4.89	44	18	<b>1.93</b>	0.80 - 4.65
> 67	16	46	<b>6.43</b>	2.75 - 15.02	33	29	<b>3.57</b>	1.53 - 8.35
p-trend			<0.01				<0.01	
Standardized BMI index <sup>2</sup>								
normal	75	61	<b>1.00</b>		99	37	<b>1.00</b>	
obese	5	10	<b>2.83</b>	0.87 - 9.18	11	4	<b>0.99</b>	0.29 - 3.44
very obese	9	26	<b>3.62</b>	1.48 - 8.86	17	18	<b>2.52</b>	1.11 - 5.70
p-trend			<0.01				0.03	

<sup>1</sup>Indicator variable scores were entered as ordinal to test for a linear trend.

<sup>2</sup>See methods, body size characteristics.

Table 4. Adjusted<sup>1</sup> odds ratios (ORs) and 95% confidence intervals (CIs) for breast and hair pubertal status associated with physical activity, among 186 girls in New York City, 1997-1998

	Breast				Hair			
	Pre-pubertal		OR <sup>1</sup>	95% CI	Pre-pubertal		OR <sup>1</sup>	95% CI
	No.	Pubertal			No.	Pubertal		
	89	97			127	59		
Sedentary (hrs/wk)								
≤ 13.50	31	29	<b>1.00</b>		45	15	<b>1.00</b>	
13.51-24.50	28	36	<b>1.35</b>	0.60 - 3.04	43	21	<b>1.49</b>	0.59 - 3.76
> 24.51	30	32	<b>0.93</b>	0.38 - 2.26	39	23	<b>1.96</b>	0.78 - 4.94
p-trend <sup>2</sup>			0.89				0.16	
Total (kcal/wk) <sup>3</sup>								
≤ 1,218	27	35	<b>1.00</b>		42	20	<b>1.00</b>	
1,218-2,548	32	29	<b>0.97</b>	0.44 - 2.15	44	17	<b>0.65</b>	0.27 - 1.57
> 2,548	30	33	<b>0.89</b>	0.39 - 2.02	41	22	<b>1.04</b>	0.45 - 2.40
p-trend			0.78				0.94	

<sup>1</sup>Adjusted for age, race/ethnicity, height, and wt/ht.

<sup>2</sup>Indicator variable scores were entered as ordinal to test for a linear trend.

<sup>3</sup>Moderate and vigorous total activities.

Table 5. Adjusted<sup>1</sup> odds ratios (ORs) and 95% confidence intervals (CIs) for breast and hair pubertal status associated with tertiles of average daily dietary intake among 172 girls in New York City, 1997-1998

	Breast				Hair			
	Pre-Pubertal		OR <sup>1</sup>	95% CI	Pre-Pubertal		OR <sup>1</sup>	95% CI
	No.	No.			No.	No.		
	89	97			127	59		
Calories (kcal <sup>2</sup> )								
≤ 2,330.75	20	37	1.00		38	19	1.00	
2,330.76-3,304.28	33	25	0.30	0.12 - 0.73	42	16	0.72	0.29 - 1.79
>3,304.29	26	31	0.42	0.16 - 1.09	35	22	1.16	1.46 - 2.91
p-trend <sup>3</sup>			0.08				0.74	
Protein (g <sup>2</sup> )								
≤ 87.54	21	36	1.00		40	17	1.00	
87.55-120.06	33	25	0.46	0.17 - 1.28	39	19	1.62	0.58 - 4.57
> 120.07	25	32	1.46	0.35 - 6.11	36	21	2.86	0.68 - 12.07
p-trend			0.70				0.15	
Carbohydrate (g)								
≤ 324.71	23	34	1.00		37	20	1.00	
324.72-446.08	29	29	0.97	0.35 - 2.64	42	16	0.80	0.28 - 2.31
> 446.09	27	30	2.05	0.40 - 10.41	36	21	1.82	0.36 - 9.31
p-trend			0.49				0.59	
Total fat (g)								
≤ 72.24	22	35	1.00		37	20	1.00	
72.25-108.52	28	30	0.61	0.22 - 1.69	39	19	0.71	0.25 - 2.01
> 108.53	29	28	0.93	0.12 - 4.35	39	18	0.81	0.16 - 4.01
p-trend			0.81				0.73	
Saturated fat (g)								
≤ 27.64	22	35	1.00		38	19	1.00	
27.65-42.20	26	32	0.54	0.20 - 1.48	38	20	0.81	0.29 - 2.25
> 42.21	31	26	0.30	0.07 - 1.29	39	18	0.71	0.17 - 3.01
p-trend			0.11				0.64	
Monounsaturated fat (g)								
≤ 29.27	22	35	1.00		37	20	1.00	
29.28-44.00	28	30	0.65	0.24 - 1.81	38	20	0.73	0.26 - 2.06
> 44.01	29	28	0.83	0.17 - 4.02	40	17	0.48	0.09 - 2.49
p-trend			0.73				0.39	
Polyunsaturated fat (g)								
≤ 14.93	23	34	1.00		41	16	1.00	
14.94-21.80	27	31	1.05	0.41 - 2.73	36	22	2.46	0.89 - 6.76
> 21.81	29	28	1.21	0.28 - 5.08	38	19	3.17	0.66 - 15.10
p-trend			0.05				0.11	
Crude fiber (g)								
≤ 4.95	24	33	1.00		39	18	1.00	
4.96-6.98	25	33	1.45	0.59 - 3.55	37	21	1.83	0.72 - 4.65
> 6.99	30	27	1.02	0.31 - 3.64	39	18	1.23	0.35 - 4.32
p-trend			0.89				0.64	



	Breast				Hair			
	Pre-Pubertal		OR <sup>1</sup>	95% CI	Pre-Pubertal		OR <sup>1</sup>	95% CI
	No.	No.			No.	No.		
	89	97			127	59		
Vitamin A (IU <sup>2</sup> )								
≤ 7,938.36	20	37	1.00		36	21	1.00	
7,938.37-13,287.28	27	31	0.70	0.27 - 1.80	38	20	0.96	0.38 - 2.42
> 13,287.29	32	25	0.75	0.28 - 2.02	41	16	1.16	0.42 - 3.20
p-trend			0.60				0.78	
Folate (μg <sup>2</sup> )								
≤ 361.24	18	39	1.00		32	25	1.00	
361.25-543.01	28	30	0.57	0.23 - 1.43	38	20	0.57	0.23 - 1.45
> 543.02	33	24	0.62	0.22 - 1.70	45	12	0.42	0.14 - 1.23
p-trend			0.38				0.11	
Retinol (IU)								
≤ 2,266.56	16	41	1.00		35	22	1.00	
2,266.57-4,078.46	29	29	0.62	0.23 - 1.65	35	23	1.84	0.70 - 4.85
> 4,078.46	34	23	0.52	0.20 - 1.38	45	12	0.94	0.34 - 2.58
p-trend			0.21				0.78	
Carotene (IU)								
≤ 4,538.60	22	35	1.00		35	22	1.00	
4,538.61-9,068.57	28	30	0.56	0.23 - 1.40	41	17	0.49	0.19 - 1.24
> 9,068.58	29	28	0.81	0.31 - 2.15	39	18	0.85	0.32 - 2.26
p-trend			0.70				0.71	
Vitamin C (mg <sup>2</sup> )								
≤ 144.43	21	36	1.00		33	24	1.00	
144.44-238.05	30	28	0.64	0.26 - 1.57	38	20	0.67	0.27 - 1.62
> 238.06	28	29	0.59	0.22 - 1.60	44	13	0.20	0.07 - 0.63
p-trend			0.31				<0.01	
Vitamin D (IU)								
≤ 346.78	17	40	1.00		33	24	1.00	
346.79-549.26	26	32	0.94	0.37 - 2.41	39	19	1.18	0.46 - 3.02
> 549.27	36	21	0.48	0.17 - 1.38	43	14	0.89	0.31 - 2.56
p-trend			0.15				0.79	
Vitamin E (mg)								
≤ 8.75	18	39	1.00		36	21	1.00	
8.76-16.10	25	33	0.69	0.26 - 1.81	31	27	1.76	0.67 - 4.64
> 16.11	36	21	0.51	0.19 - 1.42	48	9	0.59	0.19 - 1.86
p-trend			0.20				0.31	

<sup>1</sup>Adjusted for calories, age, race/ethnicity, height, wt/ht. Total caloric intake model not adjusted for calories.

<sup>2</sup>Abbreviations: kilocalories (kcal); grams (g); milligrams (mg); international units (IU); micrograms (μg).

<sup>3</sup>Indicator variable scores were entered as ordinal to test for a linear trend.

# Characteristics Associated with Recent Recreational Exercise Among Women 20 to 44 Years of Age

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**ABSTRACT.** Data on 1,501 control women from a multi-center, population-based, case-control study of breast cancer were used to examine characteristics associated with recreational exercise during the year prior to the interview among women 20 to 44 years of age. In a univariate analysis, higher levels of recreational exercise were associated with: higher education; higher family income; white race; previous participation in recreational exercise above the median level at ages 12 to 13 and at age 20; being nulliparous; ever lactating; being a never or past smoker; having a low *current* Quetelet's index (QI: weight in kilograms divided by height in meters squared); and living in Atlanta or Seattle (compared to New Jersey). In a multiple linear regression model, independent predictors of higher levels of recreational exercise were: participation in higher levels of exercise at 20 years of age; having a low *current* QI; and never having smoked. Though all women should be encouraged to participate in exercise, these findings identify subgroups of women that may need targeting when developing exercise intervention programs. [Article copies available for a fee from The Haworth Document Delivery Service: 1-800-342-9678. E-mail address: <getinfo@haworthpressinc.com> Website: <<http://www.HaworthPress.com>> © 2000 by The Haworth Press, Inc. All rights reserved.]

**KEYWORDS.** Physical activity, exercise, women

## INTRODUCTION

Exercising has been associated with many health benefits in women, including reduced risks of overall mortality, cardiovascular disease, diabetes, osteoporosis, obesity, colon cancer, and mental illness (USDHHS, 1996; Eyler et al., 1997). It may also protect against female reproductive cancers (Eyler et al., 1997; USDHHS, 1996). Despite established health-benefits, the majority of U.S. women do not participate in regular, sustained, leisure-time physical activity. In two nationwide surveys only about 20% of women, 18 years of age or older, report exercising five times or more per week for at least 30 minutes per episode (USDHHS, 1996).

In addition to illuminating the health benefits of exercise it is also important to characterize exercisers from non-exercisers so that intervention programs be effectively tailored to promote exercise. It is well documented that a higher percent of younger, white, higher-educated, and higher-income women participate in exercise than older, non-white, less-educated, and lower-income women, respectively (Casper-

sen et al., 1995; Eyler et al., 1997; Folsom et al., 1991; Ford et al., 1991; King et al., 1992; Stephens et al., 1985; USDHHS, 1996). However, non-demographic characteristics of women exercisers are less established partly due to the limited research. Studies of non-demographic characteristics have explored lifestyle (Sallis et al., 1989; Boffetta et al., 1990; McTiernan et al., 1998; Sternfeld et al., 1999; Rockhill et al., 1999) and body size (Sallis et al., 1989; Boffetta et al., 1990; McTiernan et al., 1998; Sternfeld et al., 1999; Rockhill et al., 1999), while only a few have considered reproductive history (Verhoef et al., 1994; McTiernan et al., 1998; Sternfeld et al., 1999; Rockhill et al., 1999), menstrual history (McTiernan et al., 1998; Rockhill et al., 1999), and exogenous hormone use (McTiernan et al., 1998; Rockhill et al., 1999). Methodological issues including examining different aged women as well as dissimilar definitions of exercise and characteristics hinder comparisons of these studies' results. Characterizing non-exercisers is needed to effectively tailor exercise programs. For example, to increase exercise participation mothers of young children may need assistance resolving child care issues while overweight women may need help overcoming psychological barriers, such as self-efficacy.

We explored differences between women participating in higher versus lower levels of exercise due to the low prevalence of regular, female exercisers coupled with the paucity of information on the profiles of young, women exercisers (Verhoef et al., 1994; Rockhill et al., 1999; Sternfeld et al., 1999). To do this, data from a multi-center, population-based sample of women, 20 to 44 years of age, was used. This study's findings afford the opportunity to examine the consistency of characteristics of young, women exercisers. Finally, the characteristics we investigate, including the non-demographic ones, are associated with diseases such as osteoporosis, cardiovascular disease, and reproductive cancers. If the characteristics also relate to exercise, future studies of exercise-disease relations should consider them as confounders.

## METHOD

### *Participants*

The participants and methods have been previously described (Britton et al., 1995). In brief, 1,501 women from Atlanta, GA, central New Jersey, or Seattle, WA participated (Table 1). Due to the sampling



TABLE 1 (continued)

	Quartile of exercise (relative units)										
	Total	Q1		Q2		Q3		Q4		$\chi^2$	
	n	(1.62-3.35)		(3.36-13.54)		(13.55-35.00)		(35.01-98.00)		p-value <sup>a,b</sup>	
	n	n	%	n	%	n	%	n	%		
<b>Parity</b>											
0	335	91	27.2	68	20.3	107	31.9	69	20.6		
1	297	102	34.3	58	19.5	77	25.9	60	20.2		
2	502	128	25.5	140	27.9	112	22.3	122	24.3		
3	240	74	30.8	50	20.8	68	28.3	48	20.0		
≥4	126	40	31.7	33	26.2	29	23.0	24	19.0	0.012	
<b>Age at first birth (years in tertiles, parous women)</b>											
< 22	415	143	34.5	89	21.4	95	22.9	88	21.2		
22-26.9	369	101	27.4	92	24.9	94	25.5	82	22.2		
≥27	382	100	26.2	101	26.4	97	25.4	84	22.0	0.206	
<b>Lactation (parous women)</b>											
Never	450	158	35.1	96	21.3	94	20.9	102	22.7		
Ever	716	186	26.0	186	26.0	192	26.8	152	21.2	0.002	
<b>Induced abortions (gravid women)</b>											
Never	933	266	28.5	227	24.3	237	25.4	203	21.8		
Ever	352	110	31.3	75	21.3	94	26.7	73	20.7	0.585	
<b>Miscarriages (gravid women)</b>											
Never	965	284	29.4	226	23.4	242	25.1	213	22.1		
Ever	320	92	28.8	76	23.8	89	27.8	63	19.7	0.710	
<b>Age at menarche (years)</b>											
<12	348	95	27.3	90	25.9	89	25.6	74	21.3		
12	402	131	32.6	83	20.6	96	23.9	92	22.9		
13	444	122	27.5	105	23.6	132	29.7	85	19.1		
≥14	305	86	28.2	71	23.3	76	24.9	72	23.6	0.344	
<b>Menopausal status</b>											
Pre-menopausal	1310	371	28.3	314	24.0	339	25.9	286	21.8		
Post-menopausal <sup>c</sup>	56	19	33.9	8	14.3	19	33.9	10	17.9		
Post-menopausal <sup>d</sup>	130	45	34.6	27	20.8	33	25.4	25	19.2	0.347	
<b>Oral contraceptives (months)</b>											
0-6	425	137	32.2	92	21.6	99	23.3	97	22.8		
≥ 6-59.9	570	155	27.2	126	22.1	163	28.6	126	22.1		
≥ 60-119.9	321	95	29.6	82	25.5	79	24.6	65	20.2		
≥ 120	185	48	25.9	50	27.0	52	28.1	35	18.9	0.360	
<b>Non-contraceptive hormones</b>											
Never	1358	386	28.4	324	23.9	354	26.1	294	21.6		
Ever	139	46	33.1	26	18.7	39	28.1	28	20.1	0.439	

TABLE 1 (continued)

	Quartile of exercise (relative units)										
	Total	Q1		Q2		Q3		Q4			
	(n)	(1.62-3.35)		(3.36-13.54)		(13.55-35.00)		(35.01-98.00)			$\chi^2$
	n	n	%	n	%	n	%	n	%		p-value <sup>a,b</sup>
<i>Usual alcohol intake (drinks/week)</i>											
Nondrinker	576	188	32.6	133	23.1	131	22.7	124	21.5		
<7	754	197	26.1	181	24.0	216	28.6	160	21.2		
≥7	167	48	28.7	35	21.0	46	27.5	38	22.8	0.127	
<i>Cigarette smoking</i>											
Never	817	222	27.2	196	24.0	218	26.7	181	22.2		
Past	310	77	24.8	65	21.0	95	30.6	73	23.5		
Current	370	133	35.9	89	24.1	80	21.6	68	18.4	0.007	
<i>Quetelet's index at age 20 years (weight in kg/height in m<sup>2</sup>; tertiles)</i>											
<19.5	511	144	28.2	131	25.6	133	26.0	103	20.2		
19.5-21.49	453	120	26.5	94	20.8	126	27.8	113	24.9		
≥21.5	505	159	31.5	118	23.4	126	25.0	102	20.2	0.193	
<i>Quetelet's index (weight in kg/height in m<sup>2</sup>; tertiles)</i>											
<23	478	118	24.7	99	20.7	134	28.0	127	26.6		
23-26.9	447	112	25.1	101	22.6	130	29.1	104	23.3		
≥27	471	168	35.7	125	26.5	102	21.7	76	16.1	<0.0001	
<i>Caloric intake in past year (kcal/day in quartiles)</i>											
<1,129	363	102	28.1	78	21.5	108	29.8	75	20.7		
1,129-1,455.9	363	101	27.8	91	25.1	92	25.3	79	21.8		
1,456-1,830.9	363	107	29.5	93	25.6	96	26.4	67	18.5		
≥1,831	362	104	28.7	83	22.9	85	23.5	90	24.9	0.498	

<sup>a</sup>p-values presented for unadjusted chi-square test.

<sup>b</sup>Information was missing on the following number of subjects: age at menarche (2), abortions (1), miscarriages (1), menopausal status (5), family income (36), race (2), quetelet's index at age 20 (32), quetelet's index at interview (105), usual alcohol intake (4), smoking (4), and caloric intake in the past year (50).

<sup>c</sup>Naturally postmenopausal, and those who are surgically postmenopausal with no ovaries remaining.

<sup>d</sup>Surgically postmenopausal with ovaries remaining, and those who are postmenopausal due to medical and unknown reasons.

Abbreviations: VOC/TECH vocational or technical

procedure the age distribution was skewed towards the higher end of the age range (range [20-44]; 25th, 50th, and 75th percentiles are 36, 40, and 42, respectively). Most women were white (79%). College or post-graduate education was reported by 38% of the women. Among the remaining women, 35% had either some college or vocational/technical training beyond high school, and 27% had at most a high

school (or equivalent) degree. Almost half of the sample reported an annual family income of at least \$50,000.

### Measures

Trained interviewers administered a structured questionnaire at the participants' homes (Brinton et al., 1995). Women were asked about demographic characteristics, reproductive and menstrual history, exogenous hormone use, body size, lifestyle habits, and dietary intake (Potischman et al., 1997). Anthropometric measurements were taken (Swanson et al., 1996). Quetelet's index (QI; weight in kilograms divided by height in meters squared) was calculated using the measurements (*current QI*) and self-reported weight and height at age 20 (*age 20 QI*).

The frequency of moderate (e.g., brisk walking, volleyball, recreational tennis, softball, leisurely cycling, or golfing) and vigorous (e.g., lap swimming, dance, basketball, gymnastics, running, fast cycling, aerobics, or field hockey) recreational exercise was assessed (Gammon et al., 1998). Women reported their activity frequency into pre-defined categories for three time periods (ages 12 to 13 years, age 20 years, and the year prior to the interview). To create an activity score, metabolic equivalent scores of five and nine were assigned to moderate and vigorous exercise, respectively (Godin et al., 1985). These scores, weighted by the midpoint of the exercise frequency expressed in times per week, were summed. For example, participation in moderate exercise 2 to 3 times per week ( $5 \times 2.5 = 12.50$ ) and vigorous exercise never or less than once per month ( $9 \times [0.5/4.33] = 1.04$ ) resulted in 13.54 relative units (RU) of weekly exercise. Recreational exercise was classified into quartiles. This paper focuses on recreational exercise the year prior to the interview (hereafter referred to as *past year exercise*).

### Procedure

The original aims were to investigate the relation between breast cancer risk and oral contraceptive (OC) use, adolescent diet, as well as alcohol among women 20 to 44 years of age (Brinton et al., 1995). Only information on women without breast cancer (the controls) is presented. The sample was identified from May 1, 1990 to December



31, 1992, by random digit dialing (Waksberg, 1978). Controls were frequency-matched by 5-year age groups and geographic residence to the expected breast cancer case distribution. Overall control response rate was 71.2 percent.

### Analyses

Mantel-Haenszel chi-square tests were used to determine if characteristics, as defined in Table 1, were associated with *past year* exercise (Fleiss, 1981). Tests were conducted without adjustment; adjusting for geographic site; and adjusting for age and geographic site. Results were nearly identical, thus the unadjusted are presented. A multiple linear regression model, referred to as the full model, was fit to examine the relation between a characteristic and *past year* exercise, while simultaneously adjusting for other characteristics (Kleinbaum et al., 1988). This model included indicator (geographic site, age, marital status, education, family income, race, the two summary variables described below, menopausal status, OC and non-OC hormone use, usual alcohol intake, cigarette smoking, and *past year* caloric intake) as well as continuous variables (exercise at 12 to 13 and 20 years of age, age at menarche, *current QI*).

To avoid models with collinear variables, two summary variables were created to combine categorical characteristics strongly associated in our data. The first combined gravidity, induced abortion, and miscarriage while the second combined parity, age at first birth, and lactation. *Age 20 QI* was omitted from the full model as it was strongly associated with *current QI* ( $r = 0.54$ ;  $p$  value = 0.0001) and, of the *QIs*, it was a weaker predictor of *past year exercise*.

Backward elimination was used to determine the best predictive model, i.e., the model with the fewest variables, of *past year exercise*. A  $p$ -value less than or equal to 0.05 was required to remain in the model. Indicator variables were considered as a group using the  $p$ -value for testing the null hypothesis that all indicator variable regression coefficients were zero. Several full models, excluding selected variables at the outset, were fit to ascertain the best predictive model. Finally, age-specific analyses were performed to examine if predictors of *past year exercise* levels differed by interview age. No new significant predictors were revealed (data not shown).

## RESULTS

The median value of *past year* (13.54 RU) and age 20 (14 RU) exercise were similar, but in sharp contrast to that at 12 to 13 years of age (47.5 RU). As demonstrated in Figure 1, participation in vigorous activity was not necessary to be ranked in higher levels of *past year* exercise. For instance, participation in moderate activities 2 to 3 times

FIGURE 1. Combinations of Moderate and Vigorous Recreational Exercise Categories in Each of the Past Year Recreational Exercise Quartiles, Among 1,501 Women 20 to 44 Years of Age, Atlanta, Central New Jersey, and Seattle, 1990-1992

		Past year vigorous recreational exercise					
		<1 time/ month	1-3 times/ month	1 time/ week	2-3 times/ week	4-6 times/ week	Daily
Past year moderate recreational exercise	<1 time/month						
	1-3 times/month						
	1 time/week						
	2-3 times/week						
	4-6 times/week						
	Daily						

Quartile	Relative units	Shade
First	1.62-3.35	
Second	3.36-13.54	
Third	13.55-35.00	
Fourth	35.01-98.00	

or more per week was generally sufficient to classify a woman in the two upper quartiles of *past year* exercise.

Several characteristics were associated with *past year* exercise (Table 1). Women who participated in higher exercise levels at 12 to 13 or 20 years of age were more likely to participate in higher *past year* exercise levels. Women with lower versus higher *current QIs* reported higher *past year* exercise levels. Never or past smokers were more likely than current smokers to report higher *past year* exercise levels; approximately 50% of never and of past smokers, in contrast to 40% of current smokers, reported *past year* exercise levels above the median. Among other characteristics, residing in Atlanta or Seattle, having a higher education, having a higher family income, being of white race, being nulliparous, and ever lactating were significantly associated with higher levels of *past year* exercise.

Exercise at 20 years of age, cigarette smoking, and *current QI*, which were significant in the full model, remained as the only-significant variables in the best predictive model. Regression coefficients were nearly identical in the two models, thus, only the latter is shown (Table 2). Current smokers and women with higher *current QI* had lower *past year* exercise levels. Exercise at 20 years of age was positively associated with *past year* exercise levels and accounts for five of the eight percent of the explained variance. When the full model

TABLE 2. The Parsimonious, or Best Predictive Multiple Linear Regression Model of Past Year Recreational Exercise (Relative Units) with the Fewest Variables, Among 1,310 Women 20 to 44 Years of Age, Atlanta, Central New Jersey, and Seattle, 1990-1992

Independent predictors <sup>a,b</sup>	Regression Standard		
	Coefficient	error	p-value
Recreational Exercise at 20 years of age (RU <sup>c</sup> )	0.20	0.02	0.0001
Current smoker (versus never)	-4.10	1.36	0.0026
Past smoker (versus never)	2.38	1.46	0.1045
Quetelet's index	-0.51	0.10	0.0001

<sup>a</sup> 190 women with missing information on at least one of the characteristics in Table 1 were excluded from this analysis.

<sup>b</sup>  $F_{4,1308} = 27.40$ ;  $p\text{-value} = 0.0001$ .  $R^2 = 0.08$ .

<sup>c</sup> Relative Units (RU); Quetelet's index (weight in kilograms/height in meters squared).

excluded exercise at earlier ages the significant predictors of *past year* exercise remained the same.

### DISCUSSION

In our study of women aged 20 to 44, those who exercised at earlier ages were more likely to be exercising during the year before the interview. This result, a relation between exercise participation at younger and older ages, confirms one national cross-sectional survey of men and women, 22 years of age or older (Bucher, 1974). Yet, it contrasts the findings of a cross-sectional survey, conducted in San Diego, California, of 768 women 18+ years of age (Sallis et al., 1989). Participants in the latter study were middle class, well-educated Caucasians, which may partly explain differences in findings. The association between exercising at younger ages and *past year* exercise became slightly stronger when our sample was restricted to Caucasian, college graduates with a family income of \$50,000 + (data not shown).

Exercise habits for a time period as long as 32 years before the interview were recalled. Not only is this task difficult, but it is plausible that current exercise habits influence the reporting of past exercise habits, thereby overestimating the association between current and past exercise habits. The recall of exercise habits at both 12 to 13 and 20 years of age should be similarly influenced. However, women reported lower levels of activity at 20 years of age relative to when they were 12 to 13 years of age. Exercise at age 20, rather than at 12 to 13 years of age, was a significant predictor of and had a stronger positive correlation with *past year* exercise.

Our findings were not supportive of a relation between *past year* exercise and exogenous hormones. It is plausible that OC users exercise to prevent weight gain, a commonly reported side effect of OCs (Rosenberg et al., 1995). In our study, last OC use was generally five or more years before interview. This may explain why we did not, but another study of current OC use did (Rockhill et al., 1999), observe an association with exercise. Non-OC hormone users are of higher socioeconomic status (Derby et al., 1993; Matthews et al., 1996; Marks et al., 1998) and report more exercise participation than never users (Johannes et al., 1994; Matthews et al., 1996; Derby et al., 1993). Nevertheless, our data and that of a study of predominantly postmenopausal women (McTiernan et al., 1998) do not provide evidence of an

association with non-OC hormone use. Due to the young ages of our women, most experienced menopause related to an oophorectomy or hysterectomy. Similar to a national sample of women, ever use of non-OC hormones was common among these surgically post-menopausal women (Brett et al., 1997).

Geographic site, education, family income, race, parity, and lactation were no longer significantly associated with *past year* exercise after simultaneous adjustment for all other characteristics. Other surveys support our univariate findings, including the relation between higher exercise levels and higher education, higher income, white race, and nulliparity (Caspersen et al., 1995; USDHHS, 1996; Eyler et al., 1997; Verhoef et al., 1994; Rockhill et al., 1999; Sternfeld et al., 1999). It may seem counterintuitive that parous women who breast-fed report more *past year* exercise than those who did not. In our study, women who breast-fed were of higher socioeconomic status, which has been linked to exercise (USDHHS, 1996).

Parity may be an indicator of the availability of leisure time for exercising. It may not have been a significant predictor in our study since women with young children were combined with those whose children were at an older age or had left home. In age-specific analyses, neither parity nor age at first birth, both of which can be viewed as indicators of whether a woman has young children at home, were significant predictors. Two studies exploring child care issues have contradictory findings on the relation between age of children at home and the mothers' exercise participation (Verhoef et al., 1994; Sternfeld et al., 1999). Future studies should obtain measures of contemporaneous child care-related activities to further elucidate these issues.

It is unclear why demographic variables were not predictors of *past year* exercise. The narrow age range of our population may account for our failure to observe a significant decline in activity levels as age increased (USDHHS, 1996; Sternfeld et al., 1999; Rockhill et al., 1999). Also, the independent predictor, smoking status, may be a proxy for socioeconomic status. Relative to never smokers, current smokers had lower mean levels of *past year* exercise and were more likely to have less than a high school education as well as to report a family income less than \$50,000. When smoking status was excluded from the full model, family income was a significant predictor of *past year* exercise. Each family income category had higher *past year* exercise levels than the reference category (< \$15,000), but there was

no dose-response relation (data not shown). Our finding, of lower exercise levels among current smokers, has been noted in some (Blair et al., 1985; Sallis et al., 1989; McTiernan et al., 1998; Sternfeld et al., 1999), but not all (Boffetta et al., 1990; Langlie, 1979) studies.

Comparison of findings across studies is hindered by non-uniform classifications of exercise. For instance, our measure is based on the frequency of moderate and vigorous exercise, whereas the Sallis et al. measure is defined as the duration of vigorous activity (Sallis et al., 1989). In our study, women participating in daily moderate activity were assigned to the upper quartile of *past year* exercise regardless of their vigorous activity. In Sallis et al., these women would be classified in the lowest activity level unless they engaged in vigorous activities.

Comparison of our measure of *past year* exercise to other constructs that may be indicative of exercise levels provides some evidence for our measure's validity. For example, an inverse association and a negative correlation ( $r = -0.14$ ;  $p\text{-value} = 0.0001$ ) between exercise levels and *current QI* was observed. This inverse association has been reported in cross-sectional, prospective, and intervention studies (Blair et al., 1985; Rockhill et al., 1999; McTiernan et al., 1998; Sternfeld et al., 1999). However, there was virtually no correlation between total caloric intake and *past year* exercise ( $r = 0.008$ ;  $p\text{-value} = 0.76$ ). Difficulties measuring caloric intake by a food frequency questionnaire may contribute to this null association since independent measurement error in an explanatory variable attenuates an association. This is further complicated by the possibility that errors in reporting exercise and caloric intake may not be independent, e.g., obese women have been found to over-report physical activity and under-report total caloric intake (Lichtman et al., 1992). Unfortunately, this cannot be examined in our data.

The weak  $R^2$  of the best predictive model could be a result of measurement error. Or, it could be that these characteristics are not strong predictors of exercise. A study strength was simultaneous examination of demographic and non-demographic characteristics. Reproductive, menstrual and exogenous hormone use characteristics have only been investigated in a few studies (Verhoef et al., 1994; McTiernan et al., 1998; Sternfeld et al., 1999; Rockhill et al., 1999). Clearly, our findings need replication before it can be concluded that these characteristics are not predictors of *past year* exercise. Future

studies should obtain detailed exercise measures and examine contemporaneous predictors, e.g., OC use and concurrent exercise.

Increasing physical activity is a national public health objective (Public Health Services, 1991). At all ages, women report less activity than men do (USDHHS, 1996). Despite the many health-related benefits of exercise it is uncertain if there is a crucial time-period to exercise to attain such benefits. In our retrospective data, participation in higher exercise levels at younger ages was associated with higher *past year* exercise levels. Thus, encouraging young females to exercise should be a priority; though increased exercise should be promoted among all women.

Furthermore, our results suggest that exercise interventions should consider subgroups of women, including smokers or those with a larger QI. These characteristics have also been independently related to many diseases such as cardiovascular disease, osteoporosis, and reproductive cancers. Independent associations with an exposure and a disease fulfill two criteria of confounding. Thus, future studies of these exercise-disease relations should consider these characteristics as confounders. Our findings are generalizable to Caucasian women, aged 20 to 44 years, of a diverse range of socioeconomic status. In addition to replicating these findings and including other racial/ethnic groups as well as older women, future studies should explore characteristics suggested by our univariate findings to be associated with *past year* exercise.

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Risk of Breast Cancer Classified by Joint Estrogen Receptor and Progesterone Receptor Status  
Among Women 20 to 44 Years of Age

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ABBREVIATIONS: AFB, age at first birth; BMI, body mass index; CBCS, Carolina Breast Cancer Study; CI, confidence interval; DCC, dextrose charcoal-coated; ER, estrogen receptor; OC, oral contraceptive; OR, odds ratio; PR, progesterone receptor; RDD, random digit dialing; WHR, waist-to-hip.

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Running Head: Joint Hormone Receptor Breast Cancer Risk

**ABSTRACT**

To gain insight into whether breast cancer tumors jointly classified by estrogen (ER) and progesterone receptor (PR) status represent diseases with differing etiologies, data from a population-based case-control study of women 20-44 years of age were analyzed. Cases included 1,556 women diagnosed between 1990 and 1992. Age- and geographic-frequency matched controls included 1,397 women identified by random digit dialing. Heterogeneity between ER+PR+ and ER-PR- tumors was most pronounced for age, race and recreational exercise at 12-13 years of age. Multivariate-adjusted odds ratios (ORs) and 95 percent confidence intervals (CIs) for ER+PR+ tumors, were: 0.64 (0.47, 0.89) for 30-34 versus 40-44 years of age; 0.89 (0.63, 1.25) for black versus white race; and 0.84 (0.68, 1.03) for exercise at 12-13 years of age above versus at or below the median. Corresponding ORs and CIs for ER-PR- tumors were: 1.24 (0.86, 1.77), 1.51 (1.07, 2.14), and 1.15 (0.90, 1.48). Risk of ER-PR- cancer in relation to menstrual and reproductive (parity and lactation) characteristics, alcohol consumption, as well as family history of breast cancer were similar to those observed for ER+PR+ tumors. These findings only modestly support the hypothesis that hormonally related risk factors have differing relationships with ER+PR+ versus ER-PR- tumors among younger women.

**Key words**

Estrogen receptors, progesterone receptors, breast neoplasms, risk factors, case-control studies

Ovarian hormones, primarily estrogen, are believed to play a role in breast cancer etiology (1, 2). The action of estrogen and progesterone on breast cell proliferation appears to be mediated by the estrogen receptor (ER) and progesterone receptor (PR) (3). Survival and response to hormonal therapy are most favorable among women diagnosed with tumors positive for both ER and PR, intermediate for tumors discordant on receptor status (ER+PR-, ER-PR+), and least favorable for tumors negative for both receptors (4-6).

Clinical implications of tumor hormone receptor status have prompted investigators to examine whether risk factors for breast cancer vary by hormone receptor status (7). Epidemiologic studies examining hormone-related breast cancer risk factors in relation to either the ER or PR status of the tumors have consistently shown that the ER+ tumor risk is positively associated with older age, white (versus black) race, and nulliparity (7, 8). More recent research has focused on determining whether the etiologies of breast cancer tumors classified by joint ER/PR status differ, with the assumption that ER+PR+ tumors are more hormonally sensitive (9-16).

Previous studies reported that risk of ER+PR+ breast cancer is positively associated with nulliparity, a later age at first birth (AFB), a later age at menarche, and a higher body mass index (BMI: weight in kg/height in m<sup>2</sup>), but that these factors were inversely related to risk of ER-PR- tumors (9, 10, 12-15). These observations suggest that tumors sub-classified by joint steroid receptor status may actually represent distinct forms of breast cancer with differing etiologies. A recent international comparison of age-specific breast cancer incidence rates by hormone receptor status led Yasui and Potter (17) to hypothesize that hormone-related factors associated with a Western lifestyle may be more strongly related to ER+PR+ breast cancer than other tumor

subtypes and that these associations may vary by menopausal status. The Carolina Breast Cancer Study (CBCS) additionally explored whether the heterogeneity among tumor subtypes varied by menopausal status (14). Among premenopausal women, a high waist-to-hip circumference ratio (WHR) was associated with an elevated risk of ER+PR+ tumors, but WHR was unrelated to ER-PR- tumor risk. Neither a family history of breast or ovarian cancer nor medical radiation exposure to the chest were related to ER+PR+ tumors, yet both increased ER-PR- tumor risk. Due to the limited number of premenopausal women in previous studies (13-15), data from a large group of mostly premenopausal women was analyzed to examine if breast cancer risk factors were associated with and varied according to tumor types subclassified by joint hormone receptor status.

## MATERIALS AND METHODS

### Study population

The Women's Interview Study of Health (WISH), undertaken primarily to evaluate whether long-term oral contraceptive (OC) use, alcohol consumption, or adolescent diet were associated with breast cancer risk in young women. Methods have been previously described (18). In this population, increased breast cancer risk has been noted among women who were OC users or alcohol drinkers, as well as those who had a late AFB, an early age at menarche, a previous breast biopsy, a first degree relative with breast cancer, or a low BMI (18-23). Breast cancer risk was not positively associated with WHR, cigarette smoking, miscarriages, or electric blanket use and was not inversely associated with recreational exercise (18, 20, 24-26).

Eligible women were 20 to 44 years of age and residents of either the metropolitan area of Atlanta, GA, the three-county area surrounding Seattle, WA, or one of five central New Jersey

counties. Cases were newly diagnosed, between May 1, 1990 and December 31, 1992, with either *in situ* or invasive breast cancer. In this population, risk factors profiles for *in situ* and invasive cases were found to be similar (27). Controls were identified using the modified Waksberg's method of random digit dialing (RDD) (28) and were frequency-matched to the expected case distribution by 5-year age group and geographic site. Relevant institutional review boards approved all protocols.

In-person interviews were completed by 1,668 breast cancer cases (85.7 percent), with subject and doctor refusals (6.6 and 5.8 percent, respectively) the primary reasons for non-participation. Subsequently, two cases were found to be ineligible. 1,505 control women (78.7 percent of those selected) participated in the interview; subject refusal was the primary reason for non-participation (12.9 percent). The overall control response rate was 71.2 percent (RDD screener response rate multiplied by interview response rate). Cases without a telephone (n=21) and controls previously diagnosed with *in situ* or invasive breast cancer (n=4) were excluded to maintain case-control comparability.

#### Data collection

Signed informed consent was obtained. A structured questionnaire (average administration = 70 minutes) was utilized to collect information on sociodemographic factors, reproductive and menstrual histories, hormone use, alcohol use, cigarette smoking, recreational exercise, medical history, and family history of breast cancer. Interviewers measured height, weight as well as waist and hip circumferences (20). For cases, ER and PR status (classified as positive, borderline, negative, or unknown) as well as stage and grade of disease were either obtained from Surveillance, Epidemiology, and End Results (SEER) reports (Atlanta and Seattle) or abstracted from medical records in a manner compatible with SEER protocols (New Jersey).

## Data analysis

Tumors borderline for hormone receptor status (ER: 2.7 percent and PR: 1.3 percent) were coded as receptor-positive (10). Breast cancers were characterized by their joint ER and PR status (ER+PR+, ER+PR-, ER-PR+, ER-PR-, or ER/PR unavailable when either receptor status was unknown).

Chi-square tests were used to determine if risk factors were associated with tumors classified by joint receptor status as well as with the availability of receptor information (29). Unordered polytomous logistic regression (SAS PROC CATMOD, SAS Institute, Cary, NC) was used to determine odds ratios (ORs) and 95 percent confidence intervals (CIs) for each joint steroid receptor subgroup compared to the same control group (30). In addition to providing information on etiologic inference, this technique identifies sources of heterogeneity between tumor subgroups.

Estimates were adjusted for age and geographic site (hereafter referred to as the age- and center-adjusted model). Joint receptor breast cancer risk was examined in relation to characteristics believed to influence risk via a hormonal pathway: BMI at interview and at 20 years of age, WHR, age at menarche, menopausal status (postmenopause defined as no period for at least six months prior to a case's diagnosis date and to a control's RDD identification date), gravidity, abortion or miscarriage, parity, AFB, lactation, OC use, years since last OC use, cigarette smoking, usual alcohol intake, moderate and vigorous exercise at three time periods (12-13 years of age, 20 years of age, year prior to interview) as well as the average of these three time periods (24). Family (mother or sister) history of breast cancer, education (high school or less/post high school, but no college degree/at least a college graduate), and race (white/black) were also examined. The 89 cases and 104 controls with unknown race/ethnicity or who



reported a racial/ethnic background with too few women to allow for meaningful analyses were excluded from further consideration. Thus, 1,556 cases and 1,397 controls were available for analysis.

After a thorough examination of characteristics measured on a continuous scale, cut-points were selected to capture the underlying relationship with the fewest categories needed to maximize the stability of estimates. Covariates were entered as indicator variables and, in general, continuous variables were dichotomized at the median using the control distribution. Individuals with missing values for a variable were excluded from any analyses pertaining to that variable.

Pairwise differences between regression coefficients among the steroid receptor case subgroups for a risk factor were assessed using a Wald's chi-square statistic (31). Incorporating the covariance between parameter estimates from the polytomous model into the chi-square statistic provides a more powerful comparison of the coefficients than a chi-square statistic based on separate logistic models, where the covariance is assumed to be zero (31).

To determine whether confounding accounted for the associations observed in the age- and center-adjusted models, all characteristics having significant risk estimates along with age and geographic site were simultaneously included in a single model (hereafter referred to as the multivariate-adjusted model). This latter model also included risk factors found to have statistically significantly different regression coefficients among steroid receptor subgroups. Estimates from other models, including one containing all of the breast cancer risk factors under consideration, regardless of significance, as well as a model with just the risk factors that were found to have risk estimates that significantly differed between steroid receptor subgroups, were not materially different (data not shown). To adjust for stage, case only models were fit. In

these models each receptor subgroup was compared to ER+PR+ subgroup.

## RESULTS

Hormone receptor status was unavailable for 22 percent of the cases (table 1). Women who resided in New Jersey or those who were younger were slightly more likely to have steroid receptor information available than women who resided in either of the other sites or than those who were older. The proportion of black and white women with receptor information available was similar (81 versus 77 percent, respectively). Although family income was statistically significantly associated with steroid receptor status availability, women above and below the \$35,000-49,999 income category were equally likely to have such information available and were more likely to have this information than women in this middle category. Twenty percent of women with *in situ* versus 90 percent of women with distant tumors had known receptor status. Among *in situ* cases, women with and without ER/PR information do not differ on age, education, or income (data not shown). Women with grade I tumors were significantly less likely to have hormone receptor information available than women with grade IV tumors. None of the other variables examined including the hormonal or lifestyle characteristics were associated with the availability of ER/PR status (data not shown).

Table 2 shows the distribution of the joint hormone receptor status of the breast cancer tumors as well as their distribution stratified by age and race. Of the 78 percent of case women with known ER/PR status, 51, 10, 10, and 30 percent of the tumors were classified as ER+PR+, ER+PR-, ER-PR+, and ER-PR-, respectively. Both age and race were associated with joint hormone receptor status ( $p < 0.01$ ). As age increased, the proportion of women with ER+PR+ tumors increased and this corresponded primarily with a decline in the proportion of women diagnosed with ER-PR- tumors. Relative to black women, white women were almost one and a

half times more likely to have ER+PR+ tumors (34 and 54 percent, respectively) but only sixty percent as likely to have ER-PR- tumors (43 and 27 percent, respectively).

In the age- and center-adjusted models, associations between hormone receptor sub-classified breast cancer tumors and gravidity, previous history of abortion or miscarriage, BMI at 20 years of age, and recreational exercise at 20 years of age as well as average recreational exercise were in the expected directions to those previously observed for breast cancer, yet the confidence intervals were wide (data not shown). Heterogeneity among the steroid receptor subgroups in their associations with these risk factors was not apparent. Thus, these factors were not considered further. Risk estimates in the multivariate-adjusted model (table 3) were similar to those observed in the age- and center-adjusted models. Overall, multivariate adjustment resulted in small changes (< 10 percent) in the magnitude of the odds ratios that tended towards the null. Age- and center-adjusted associations for WHR, AFB, alcohol, and recreational exercise at 12-13 years of age were attenuated following multivariate adjustment.

Associations observed for ER+PR+ tumors were similar to those generally reported for breast cancer risk when hormone receptor status is not considered (table 3). Risk of developing ER+PR+ tumors was elevated if women were older, had a BMI below the median, had a younger age at menarche, had a family history of breast cancer or were pre-menopausal. Furthermore, white race, higher education (at least a college degree), nulliparity, later AFB, never lactating, and greater consumption of alcohol (7 or more drinks per week) were also related, but non-significantly, to an increased risk of ER+PR+ tumors.

Many of the odds ratios estimating the relationship for hormonal (age, WHR, current cigarette smoking, as well as recreational exercise at 12-13 years of age and during the year prior to interview) and sociodemographic (race and education) characteristics in relation to ER-PR-

tumors were in the opposite direction of the risk estimates observed for ER+PR+ tumors. Albeit, in some instances risk estimates were extremely close to the null. Heterogeneity was most pronounced between the ER+PR+ and ER-PR- beta coefficients for age (30-34 versus 40-44 years of age), race, and recreational exercise at 12-13 years of age.

Age at menarche, menopausal status, alcohol consumption, as well as family history of breast cancer similarly influence breast cancer risk, regardless of tumor steroid subtype. Nulliparous women were at increased risk of all tumor types except ER-PR+ tumors. An inverse association was observed between months of lactation and each of the hormone receptor tumor subtypes, with the strongest risk reduction observed for ER+PR- tumors (multivariate adjusted OR = 0.29 and 95 percent CI (0.13, 0.66)). Finally, ever use of OCs was only modestly associated with an elevated risk of both ER- tumor types but neither ER+ tumor types. When time since last OC use was explored, risk was highest among women who used them during the five year interval prior to interview. Yet, the magnitude of the association was actually the weakest for ER+PR+ tumors; the age- and center-adjusted ORs and 95 percent CIs for OCs use within the five years prior to interview versus never use of OCs are 1.33 (0.95, 1.86), 1.82 (0.96, 3.45), 2.40 (1.17, 4.94), 1.72 (1.14, 2.60) for ER+PR+, ER+PR-, ER-PR+, and ER-PR- tumors, respectively.

Associations for the risk factors examined in relation to the discordant receptor tumors (ER+PR- or ER-PR+) were not consistently more similar to those observed for either ER+PR+ or ER-PR- tumors. In addition, the beta coefficient for ER+PR- in relation to several risk factors differed from the beta coefficients for the other tumor subtypes, however no clear pattern emerged. Since fewer women were diagnosed with the discordant tumors, our ability to compare these two subgroups with one another as well as with ER+PR+ and ER-PR- tumors was limited.

Associations for unclassified tumors differed from those observed for the other tumor subgroups for age, education, WHR, lactation, and exercise at 12-13 years of age. These findings are difficult to interpret since unclassified tumors are a mixed group of hormone receptor tumor subtypes.

Analyses restricted to premenopausal women (88 percent of the population) as well as analyses re-conducted excluding women with *in situ* (14 percent) and unknown stage (2 percent) tumors yielded results essentially unchanged from those presented in table 3 (data not shown). Adjustment for tumor stage in case only models did not materially modify the risk estimates from unadjusted models (data not shown). Due to the previously noted association between race and tumor steroid sub-type (32, 33), estimates with (table 3) and without (data not shown) adjustment for race were compared. In general, risk estimates were similar in the two models; however with adjustment for race the difference between the ER+PR+ and ER-PR- tumors' beta coefficients for parity and AFB no longer remained. Small stratum-specific sample size prevented a formal evaluation for interaction, but an examination of the odds ratios did not suggest an interaction between race and either of these reproductive factors (data not shown).

## DISCUSSION

Even within our study population's restricted age range, age was inversely related to the proportion of ER-PR- tumors but positively associated with the proportion of ER+PR+ tumors. The increased proportion of ER+PR+ breast cancer tumors for successive age categories concurs with prior reports (11, 17). Others have also noted a higher proportion of ER+PR+ tumors but a lower proportion of ER-PR- tumors in whites versus blacks (34).

This study's findings provide weak support for the hypothesis promulgated by Potter and others (10, 17); namely that ER+PR+ and ER-PR- breast cancer tumors have different risk factor

profiles. In our study, the strongest evidence supporting this hypothesis, although limited, was that the regression coefficients for ER+PR+ and ER-PR- tumors were different for age, race, and exercise at 12-13 years of age. Other evidence for risk factor profile differences is provided by several characteristics (age, WHR, current cigarette smoking, as well as recreational exercise at 12-13 years of age and during the year prior to interview) with risk estimates in opposite directions for the two tumor subtypes. On the other hand, the lack of heterogeneity among tumor subgroups for many of the reproductive and menstrual characteristics commonly considered to influence breast cancer risk through a hormonally mediated pathway provides little support for this hypothesis (35). Failure to provide stronger support may be due to the limited power of our study to detect such subtle subgroup heterogeneity.

If tumors classified by their joint hormone receptor status represent different stages of the same disease, then control for stage and tumor size would be expected to influence the observed associations. Risk estimates remained essentially unchanged in analyses considering tumor stage, providing additional support that tumors with differing steroid receptor status may be etiologically distinct. Tumor size was not examined due to concerns about its reliability. Earlier studies adjusting for tumor stage (14) or size (10) found that these characteristics did not influence risk estimates.

Our findings do not agree with previous reports of stronger associations for ER+PR+ tumors and hormone-related characteristics (9, 10, 12-15). Inconsistency may reflect differences in study design or populations. Breast cancer risk factors and the underlying biological mechanisms may vary with menopausal status (14, 36). The discussion therefore focuses on comparing our results to those of other studies that included premenopausal women since our population was 88 percent premenopausal.

Our finding of a reduced risk of ER+PR+ tumors among women with a higher BMI is consistent with one (14), but not the other (15), study of premenopausal women. In studies of premenopausal breast cancer risk that do not consider hormonal receptor subtype, an inverse or even no association is often observed for BMI (37-40). Premenopausal obesity has been associated with menstrual cycle irregularities resulting in lower estrogen and progesterone levels, which may lower breast cancer risk (38). Abdominal fat is considered more metabolically active than peripheral fat (41). Central fat has been associated with increased estrogen and testosterone levels, but decreased sex hormone binding globulin levels (38). Additionally, it has also been linked with insulin resistance, which may in turn be associated with an elevated breast cancer risk (42). However, we did not observe an association between WHR and any of the hormone receptor subgroups. This finding contrasts with the previous report of a two-fold risk of ER+PR+ breast cancer tumors in relation to a higher WHR (14) as well as with two recent studies not considering hormone receptor status that observed positive associations between WHR and pre-menopausal breast cancer risk (43, 44).

As observed in the CBCS, we found nulliparous women were at increased risk of ER+PR+ tumors (14). In contrast, nulliparous women were also at increased risk for ER-PR- tumors in our study, but not in the CBCS study. Also, the increase ER+PR+ tumor risk for older versus younger AFB that we noted is not consistent with the null association reported the in the Carolina study (14). A later versus earlier AFB has been hypothesized to increase breast cancer risk since the pregnancy-related increases in estrogen and progesterone levels (45) are not offset by the benefits associated with an earlier age at breast cell differentiation (46).

Physical activity has been hypothesized to reduce breast cancer risk by a variety of mechanisms, including an influence on menstrual cycle (47, 48) or body size characteristics (37).

A reduced risk of ER+PR+ tumors was observed in these data for higher levels of recreational exercise participation at 12-13 years of age, but not for exercise in the year prior to the interview. In a previous population-based case-control study conducted in Los Angeles, an inverse association between lifetime recreational physical activity levels and all steroid receptor tumor subgroups except ER-PR+ was observed among premenopausal women (15). Explanations for our observation of an increased risk of ER+PR- tumors in relation to recreational exercise in the year prior to interview is unclear, and may be due to chance.

Unlike the premenopausal findings in the CBCS (14), we observed no differences among ER+PR+ and ER-PR- tumors in relation to age at menarche, ever/never OC use, and family history of breast cancer. Our findings of a non-significant elevated risk across all hormone receptor status subgroups, except for ER+PR- tumors, for higher consumption of alcoholic drinks also were in disagreement to the null findings (13) and the non-significant reductions in risk (14) observed in the two previous studies of premenopausal women. As suggested previously (25), the strong decreased risk of ER+PR- breast cancer for current versus never cigarette smokers may be a chance finding, particularly in light of the large number of comparisons that we made. Finally, neither our results nor those of the CBCS (14) support differences among these two breast tumor subgroups for a previous history of an abortion or miscarriage.

Bias must be considered when interpreting the study findings. Response rates were higher among cases than controls. Selection bias from control non-participation is unlikely to explain our findings of heterogeneity among tumor subgroup associations with some, but not other, risk factors. Since each case group was compared to the same control group any selection bias would be expected to similarly affect the estimates among the tumor subgroups. Most of the associations for ER+PR+ tumors were in the expected directions based on previous studies of



breast cancer risk (35), and it is extremely unlikely that recall bias issues would only apply to cases within a specific hormone receptor status subgroup. In contrast, our WHR findings were not in the expected direction. This unexpected finding may be due to a higher refusal rate among heavier women who were invited to be controls. Yet, data from this study suggest otherwise; no differences in self-reported weight were found between participants who completed the full study interview and those only willing to complete a short non-respondent questionnaire (49).

Distributions of the breast cancer risk factors were generally similar for case women with and without hormone receptor status information available, which also argues against selection bias. Women with *in situ* and lower grade tumors were more likely to have unknown hormone receptor status than women with other stage or grade tumors. In the WISH study population, associations for *in situ* versus regional/distant tumors only differed for nulliparity, BMI, and alcohol (27). Excluding *in situ* or unknown stage tumors did not modify the table 3 risk estimates.

Numerous laboratories determined the estrogen and progesterone receptor status, primarily using the dextrose charcoal-coated (DCC) biochemical assay as opposed to immunohistochemical techniques. The higher prevalence of DCC testing reflects the time period (1990-1992) in which this study was conducted. Despite generally high agreement between these two methods, differences in classification as well as interlaboratory variability may account for discrepancies among studies' findings (50). Although prediction of prognosis and response to hormonal treatment by hormone receptor status is relatively consistent, misclassification of hormone receptor status may make it more difficult to disentangle whether the more subtle etiologic relationships vary among hormone receptor subgroups (50).

The methodological strengths of this study to examine whether associations differed

according to steroid receptor status tumor subgroups include analyses based on the largest sample size of pre-menopausal women to date. However, subgroup analyses undertaken in this study were hindered by decreased power to detect associations of small magnitude. Other study strengths include the population-based design, the wide-range of breast cancer risk factors available for analyses as well as the use of a standardized anthropometric protocol. In general, our findings did not strongly support the notion that many of the established or suspected hormonal breast cancer risk factors differ on their relationships with ER+PR+ versus ER-PR- breast cancer tumors among younger women.

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TABLE 1. Distribution of steroid receptor availability by selected characteristics among the case women 20 to 44 years of age in Atlanta, New Jersey, and Seattle, 1990-1992

	Available		Not Available		$\chi^2$
	n	%	n	%	p-value
<i>All cases</i>	1,212	78%	344	22%	
<i>Geographic site</i>					
Atlanta	380	77%	113	23%	0.02
New Jersey	396	82%	86	18%	
Seattle	436	75%	145	25%	
<i>Age (years in tertiles)</i>					
20 - 29	44	79%	12	21%	0.04
30 - 34	163	84%	30	16%	
35 - 39	367	79%	95	21%	
40 - 44	638	76%	207	24%	
<i>Race</i>					
White	1004	77%	296	23%	0.16
Black	208	81%	48	19%	
<i>Education</i>					
≤ High school	310	76%	97	24%	0.40
Post high school	421	80%	107	20%	
≥ College graduate	481	77%	140	23%	
<i>Family income*</i>					
< 15,000	98	80%	25	20%	0.03
15 - 24,999	125	81%	30	19%	
25 - 34,999	161	82%	35	18%	
35 - 49,999	193	70%	84	30%	
50 - 69,999	260	79%	70	21%	
70 - 89,999	161	78%	46	22%	
≥ 90,000	191	79%	50	21%	
<i>Stage†</i>					
In situ	43	20%	175	80%	<0.0001
Local	625	85%	110	15%	
Regional	497	91%	47	9%	
Distant	26	90%	3	10%	
<i>Tumor grade‡</i>					
I	37	76%	12	24%	<0.0001
II	168	83%	34	17%	
III	325	92%	28	8%	
IV	77	97%	2	3%	

\*Family income was missing for 23 and 4 women with and without receptor status available, respectively.

†Stage was missing for 21 and 9 women with and without receptor status available, respectively.

‡Grade information not available for New Jersey women. Additionally, grade was missing for 209 and 181 women with and without receptor status available, respectively.

TABLE 2. Distribution of joint estrogen receptor (ER) and progesterone receptor (PR) status among 1,556 breast cancer cases 20 to 44 years of age in Atlanta, New Jersey, and Seattle, 1990-1992

	Receptor Status Available								Receptor Status Not Available	
	ER+PR+		ER+PR-		ER-PR+		ER-PR-		Available	
	No.	%*	No.	%*	No.	%*	No.	%*	No.	%†
All cases	616	51	118	10	118	10	360	30	344	22
<i>Age (years)</i>										
20 - 29	14	32	5	11	7	16	18	41	12	21
30 - 34	68	42	24	15	13	8	58	36	30	16
35 - 39	186	51	33	9	37	10	111	30	95	21
40 - 44	348	55	56	9	61	10	173	27	207	24
<i>Race</i>										
White	546	54	94	9	93	9	271	27	296	23
Black	70	34	24	12	25	12	89	43	48	19

\*Percent of cases with known hormone receptor status.

†Percent of total cases (available + not available hormone receptor status).

Table 3. Multivariate adjusted\* odds ratios (ORs) and 95% confidence intervals (CI) for the association between risk factors and breast cancer risk by steroid receptor sub-type among women 20 to 44 years of age in Atlanta, New Jersey, and Seattle, 1990-92.

	(A)		(B)		(C)		(D)		(E)	
	Controls		ER+PR+		ER+PR-		ER-PR+		ER-PR-	
	No.	No.	OR (95% CI)	No.	OR (95% CI)	No.	OR (95% CI)	No.	OR (95% CI)	Not Available
<i>Age (years)</i>										
20-29	58	14	0.80 0.64, 1.01	5	0.86 0.53, 1.39	7	1.00 0.64, 1.57	18	<sup>E</sup> 1.03 <sup>+N66</sup> 0.78, 1.38	12 0.69 0.52, 0.92
30-34	210	68	<sup>B,D</sup> 0.64 0.47, 0.89	24	<sup>A,E</sup> 1.37 0.80, 2.34	13	0.66 0.33, 1.31	58	<sup>A,E</sup> 1.24 0.86, 1.77	30 <sup>B,D</sup> 0.46 0.29, 0.71
35-39	441	186	0.49 0.26, 0.93	33	0.92 0.33, 2.54	37	1.37 0.53, 3.53	111	0.97 0.51, 1.88	95 0.64 0.32, 1.27
40-44	688	348	1.00	56	1.00	61	1.00	173	1.00	207 1.00
<i>Race</i>										
White	1180	546	1.00	94	1.00	93	1.00	271	1.00	296 1.00
Black	217	70	<sup>D</sup> 0.89 0.63, 1.25	24	1.33 0.75, 2.37	25	1.55 0.87, 2.74	89	<sup>A</sup> 1.51 1.07, 2.14	48 1.06 0.72, 1.58
<i>Education</i>										
≤ High school	347	146	1.00	25	1.00	35	1.00	104	1.00	97 1.00
Post high school	508	190	0.89 0.68, 1.17	44	1.10 0.64, 1.88	45	0.88 0.54, 1.44	142	0.95 0.70, 1.29	107 0.70 0.50, 0.96
≥ College graduate	515	280	<sup>E</sup> 1.22 0.92, 1.62	49	1.07 0.61, 1.90	38	0.68 0.38, 1.19	114	0.81 0.57, 1.15	140 <sup>A</sup> 0.79 0.56, 1.12
<i>BMI (weight in kg/height in m<sup>2</sup>; median)</i>										
≤ 24.6	642	351	1.00	58	1.00	50	1.00	168	1.00	183 1.00
> 24.6	660	249	0.77 0.62, 0.96	56	1.04 0.68, 1.60	61	1.01 0.66, 1.56	176	0.91 0.70, 1.19	153 0.90 0.69, 1.18
<i>WHR (median)</i>										
≤ median	683	342	1.00	65	1.00	49	1.00	170	1.00	199 1.00
> median	644	261	0.90 0.73, 1.11	51	0.91 0.60, 1.38	63	<sup>E</sup> 1.28 0.84, 1.95	178	1.07 0.83, 1.38	137 <sup>C</sup> 0.78 0.60, 1.01
<i>Parity</i>										
Ever	1086	467	1.00	84	1.00	95	1.00	276	1.00	248 1.00
Never	311	148	1.20 0.87, 1.68	34	1.80 0.95, 3.41	23	1.03 0.53, 1.99	84	1.22 0.81, 1.82	96 1.89 1.26, 2.83

Table 3, Page 2

Controls		(A)		(B)		(C)		(D)		(E)	
		No.	ER+PR+ OR (95% CI)	No.	ER+PR- OR (95% CI)	No.	ER-PR+ OR (95% CI)	No.	ER-PR- OR (95% CI)	No.	Not Available OR (95% CI)
<i>Age at first birth (years median)</i>											
≤ 24.3	550	193	1.00	32	1.00	43	1.00	147	1.00	106	1.00
> 24.3	536	274	1.21	52	1.69	52	1.43	129	1.03	141	1.34
			0.94, 1.57		0.99, 2.86		0.87, 2.35		0.75, 1.41		0.96, 1.85
<i>Lactation (months; lowest 75th versus upper 25th percentile)</i>											
Never	421	177	1.00	35	1.00	39	1.00	131	1.00	100	1.00
≤ 12	419	191	0.99	40	0.87	40	1.15	94	0.78	92	0.90
> 12			0.76, 1.30		0.52, 1.46		0.69, 1.90		0.57, 1.08		0.64, 1.26
	246	99	<sup>B</sup> 0.8	9	<sup>A,C,D,E</sup> 0.29	16	<sup>B</sup> 0.82	51	<sup>B</sup> 0.75	56	<sup>B</sup> 0.81
			0.58, 1.12		0.13, 0.66		0.43, 1.59		0.50, 1.12		0.54, 1.22
<i>Oral contraceptive use</i>											
Never	215	87	1.00	17	1.00	9	1.00	44	1.00	48	1.00
Ever	1182	529	1.15	101	1.16	109	2.02	316	1.46	296	1.13
			0.86, 1.54		0.65, 2.06		0.98, 4.14		1.00, 2.14		0.79, 1.62
<i>Cigarette smoking</i>											
Never	743	318	1.00	78	1.00	66	1.00	191	1.00	192	1.00
Past	299	144	0.99	23	0.76	23	0.94	80	1.02	81	1.02
			0.77, 1.28		0.45, 1.27		0.56, 1.58		0.75, 1.41		0.74, 1.39
Current	351	154	<sup>B</sup> 1.11	17	<sup>A</sup> 0.48	29	0.86	89	0.89	71	0.81
			0.86, 1.44		0.27, 0.86		0.52, 1.42		0.65, 1.21		0.58, 1.12
<i>Usual alcohol intake (drinks/week)</i>											
Nondrinker	503	187	1.00	45	1.00	44	1.00	124	1.00	117	1.00
< 7	729	342	1.11	58	0.86	52	0.87	180	1.08	182	0.95
			0.88, 1.41		0.55, 1.35		0.55, 1.39		0.81, 1.43		0.71, 1.26
≥ 7	161	86	1.33	14	0.94	22	1.64	56	1.38	45	1.02
			0.94, 1.87		0.47, 1.86		0.90, 2.98		0.93, 2.06		0.66, 1.55
<i>Recreational exercise at 12-13 years of age</i>											
≤ 47.5	728	359	1.00	59	1.00	66	1.00	171	1.00	197	1.00
> 47.5	669	257	<sup>D</sup> 0.84	59	0.95	52	0.87	189	<sup>A,E</sup> 1.15	147	<sup>D</sup> 0.83
			0.68, 1.03		0.64, 1.42		0.58, 1.30		0.90, 1.48		0.65, 1.07

	(A)		(B)		(C)		(D)		(E)			
	Controls No.	ER+PR+	ER+PR- No.	OR (95% CI)	ER-PR+ No.	OR (95% CI)	ER-PR- No.	OR (95% CI)	Not Available No.	OR (95% CI)		
		No.		OR (95% CI)		No.		OR (95% CI)		No.	OR (95% CI)	
Recreational exercise for year prior to interview												
≤ 13.5	722	292	1.00	1.00	46	1.00	1.00	1.00	199	1.00	170	1.00
> 13.5	675	324	1.12	C,D 1.6	72	1.06, 2.40	B 0.84	B 0.88	161	0.68, 1.12	173	1.04
			0.91, 1.37				0.55, 1.26					0.81, 1.34
Age at menarche (years)												
≤ 12	711	343	1.00	1.00	61	1.00	1.00	1.00	202	1.00	190	1.00
≥ 13	685	272	0.77	0.93	57	0.63, 1.38	0.87	0.78	158	0.61, 1.00	153	0.81
			0.63, 0.94				0.58, 1.30					0.63, 1.04
Family history of breast cancer												
Never	1304	525	1.00	1.00	106	1.00	1.00	1.00	306	1.00	288	1.00
Ever	93	91	2.31	1.69	12	0.89, 3.22	1.93	2.53	54	1.74, 3.69	56	2.63
			1.67, 3.18				1.03, 3.61					1.81, 3.82
Menopausal status												
Pre-menopausal	1210	559	1.00	1.00	107	1.00	1.00	1.00	317	1.00	305	1.00
Post-menopausal	182	56	0.66	0.77	11	0.39, 1.53	0.65	0.78	42	0.52, 1.15	39	0.70
			0.46, 0.93				0.33, 1.29					0.47, 1.06

\*Estimates are simultaneously adjusted for all of the other factors included in table as well as for study site.

†Letter superscripts identify statistically significant differences between steroid receptor sub-type specific estimates

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**Environmental Risk Factors for Breast Cancer Among African-American Women**

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No reprints will be available.

**Keywords:** environmental, breast cancer, African-American, environment-gene, occupational, risk

**Abbreviations:** DDT - bis(4-chlorophenyl)-1,1,1-trichloroethane, DDE - bis(4-chlorophenyl)-1,1-dichloroethene, PCB-polychlorinated biphenyls, PBB-polybrominated biphenyls, TCDD-2,3,7,8-tetrachlorodibenzodioxin, 8-OHdG-8-hydroxydeoxyguanosine, ODD-oxidative damage, GST-glutathione-S-transferase, NAT-N-acetyl transferase, PAH-polycyclic aromatic hydrocarbons, HAA-heterocyclic aromatic amines, BMI-body mass index, SES-socioeconomic status, CBCS- Carolina Breast Cancer Study, EMF- electromagnetic fields, OR-odds ratio, CI-95% confidence interval, OCs-organochlorines

**Abstract:** There are few established environmental carcinogens for breast cancer in women. Nevertheless, environmental factors are thought to explain much of the international variation in breast cancer risk and possibly differences among racial/ethnic groups. Along with lifestyle, some adverse exposures may be higher in minority racial/ethnic groups and in underserved populations that experience higher ambient contamination. Associations have been found between environmental agents and breast cancer in subgroups of women who can be identified by common susceptibility traits as well as by timing of exposures at certain milestones of reproductive life. Susceptibility can be defined by social, environmental, and genetic modalities—factors that may predominate in certain racial/ethnic groups but that also transcend racial/ethnic boundaries. For example, genes involved in transcription and estrogen metabolism have rapid variants that are more prevalent among African-Americans, yet risk accompanying metabolic changes from these genes will prevail in all racial/ethnic groups.

Lack of reliable exposure assessment remains a principal obstacle to elucidating the role of environmental exposures in breast cancer. Resources must be identified and consolidated that will enable scientists to improve exposure assessment and to assemble studies of sufficient size to address questions regarding exposure, susceptibility and vulnerability factors in breast cancer. Breast cancer studies must be expanded to examine combinations of chemicals as well as competing or complementary exposures such as endogenous hormones, dietary intake and behavioral factors.

## **Introduction**

Other than radiation and alcohol, few environmental exposures have been clearly associated with breast cancer etiology in any racial/ethnic group. Nevertheless, environmental etiologies have been invoked to explain the failure of known risk factors to account entirely for the occurrence of breast cancer. Based on studies of twins and of families with cancer in Sweden, recent estimates are that more than 60 percent of breast cancer risk has an environmental component (1,2). Environmental factors, including diet, are also thought to account for some of the disparity in breast cancer rates among racial/ethnic groups. African-American and Caucasian women in the U.S. have similar overall rates of breast cancer. But, compared with Caucasian women, African-American women have a higher incidence of breast cancer before 40 years of age, and their prognosis following breast cancer diagnosis is poorer across all ages (3). Differences in breast cancer incidence among racial/ethnic groups within the U.S., along with wide international variability, suggest that environmental factors contribute to the etiology of the disease. Among African-American women within the U.S., breast cancer mortality also varies geographically (4).

Furthermore, it has been suggested that disparate exposures in conjunction with different genetic susceptibility may make African-Americans more vulnerable than Caucasians to the insults of exogenous

carcinogens (4). Therefore, investigation of environmental exposures that may have a differential impact upon breast cancer etiology in African-American women should be considered, and studies should seek to identify risk factors that might reduce or even eliminate these disparities in incidence and mortality. Of particular urgency is the failure to understand of the higher breast cancer incidence among young African-American women which may be attributable to risk factors other than established reproductive endpoints (5).

The biological basis for investigation of breast cancer and environment is broad (Table 1). First, as mutagens or tumor promoters, environmental chemicals may influence carcinogenesis at many junctures in its pathway; they may also modulate the metabolic processes that activate and detoxify these pathways. In addition, environmental contaminants, acting as hormone mimics, may affect breast development and cell differentiation in early life. Therefore, to qualify as a mammary carcinogen, an environmental exposure should have potential to operate within this proposed scheme. Environmental factors may be relevant to particular characteristics of African-American breast cancer: early onset, poor prognosis, and early life events such as a younger age at menarche. This temporal framework of reproductive events is described elsewhere in this symposium monograph. {ED: CITE L.BERNSTEIN PAPER}

Members of the Conference Workshop on Environmental Issues and Breast Cancer in African-American Women (September 2000) argued that while subgroups at increased breast cancer risk may be more readily identifiable in racial/ethnic groups, such entities are just as likely to exist across race and ethnicity. Examples are women with high body mass index (BMI), variants in BRCA1/2, and low socioeconomic status (SES). Race/ethnicity does not imply "genetically homogenous"; thus it is necessary to consider criteria other than just skin color to classify "at-risk" susceptible subgroups. For instance "blacks" of various ancestry (i.e., African, Carribean) residing within the U.S. are genetically heterogenous, and therefore for some scientific hypotheses it would be methodologically inappropriate to consider these groups together.

*Environmental exposures that may be relevant for breast cancer etiology and progression.* From laboratory studies, a number of potential breast cancer carcinogens have been identified that are also known environmental contaminants (Table 2). More than 30 mammary carcinogens in animals and at least twice that many human carcinogens have been characterized (6-8). Many of these chemicals are more likely to be encountered in an industrial environment than in settings that most women experience daily. With the advent of the so-called "endocrine disruptor" phenomenon (9), hormonally active environmental chemicals have been targetted as potential risk factors for reproductive toxicity, including breast cancer. In a recent survey, 86 potential mammary toxins were identified and measured in household dust and air, including 9 known mammary carcinogens and 77 hormonally active agents or closely related compounds. Of these more than 30% were detected at least once in a pilot study of three

homes (7 samples) (10). A study of occupational exposure to these compounds found approximately 30% of women to have hormonally active exposures in their workplace (11).

The carcinogenic polycyclic aromatic hydrocarbons (PAH; e.g. 3-methylcholanthrene and dimethylbenzanthracene [DMBA]) and heterocyclic amines (HAA) are ubiquitous in the environment and arise from many ambient and food sources. In addition, a large variety of compounds in commerce today (styrene, chlorinated alkanes and alkenes, pesticides) are analogs of chemicals listed in Table 2; not all have been tested for carcinogenic potential. Other chemicals (bis(4-chlorophenyl)-1,1,1-trichloroethane-DDT, polychlorinated biphenyls-PCBs, atrazine) that are not acknowledged breast carcinogens are known to enhance or inhibit tumor growth (12,13). The organochlorines, including DDT, PCB, 2,3,7,8-tetrachlorodibenzodioxin (TCDD), polybrominated biphenyls (PBB) and phenoxy acids as well as solvents, may reduce cell mediated immune function (14). A number of environmental agents have been investigated in epidemiologic studies with respect to their potential influence on breast cancer risk. Few of these have been examined in terms of their specific relation to breast cancer risk in African-American women. The quality of the exposure assessments in studies conducted to date vary greatly, and there are few or no data on exposures to most of these chemicals. Therefore obtaining better exposure information is perhaps the most challenging part of environmental cancer research.

Occupational exposures to chemicals are usually higher than those in other surroundings, providing the opportunity to determine cancer risk among workers, either by identifying work-related exposures within specific cancer types or by enumerating cancer occurrence within jobs that have known chemical or physical contamination. Studies have investigated incidence or mortality of all cancer types in specific occupations, and some results support an environmental etiology for breast cancer in both African-American and Caucasian women workers. There are limitations to such studies, however (see Goldberg et al.(15) for a discussion of these issues). Of primary concern in many of the studies is the imprecise or poorly classified exposures or disease status, the examination of breast cancer mortality rather than incidence, and the lack of information on confounders. Furthermore, occupational cohorts often have too few women diagnosed with breast cancer, while case-control studies often have too few women within a given occupational group available for analyses. Either situation reduces statistical power to examine hypotheses. Poor assessment of exposure or disease is likely to result in attenuated risk estimates, while failure to consider confounders can over- or under-estimate study findings. Finally, conclusions drawn from mortality studies of breast cancer can often be misleading with regard to understanding etiology because approximately two-thirds of women who survive the disease are excluded. However, such research often points the way to more carefully designed analytical studies.

In occupational research, evidence that chemical exposures may increase risk for breast cancer incidence or mortality is most consistent among school teachers and managerial personnel (16-18). However, it is

not obvious that these jobs would have high carcinogenic exposures, and it is possible that other risk factors such as reproductive history were not adequately assessed. (19,20). Among the multi-ethnic occupational studies is a large scale retrospective analysis that included approximately 4,000 breast cancer deaths among African-Americans, both African-American and Caucasian women were found to have higher risk of mortality from breast cancer if they had experienced higher levels of various metal exposures (21). In addition, solvents and styrene posed an increased breast cancer mortality risk in this study. Among women who had worked in chemical, pharmaceutical, printing, or electrical equipment manufacturing industries in New Jersey, the risk for death from breast cancer among African-Americans, but not Caucasians, was elevated (22). A recent study of hairdressers and barbers, who are exposed to a variety of genotoxic and mutagenic chemicals, included 19,980 deaths among Caucasian women and 3,602 deaths among African-American women (23). Slight elevations in risk of breast cancer mortality were found: mortality odds ratios (ORs) 1.10 and 95% confidence intervals (CIs) 1.03-1.17 for Caucasians, 1.15 (0.98-1.36) for African-Americans. Other occupational studies, though not including minority women, support the association of an elevated breast cancer risk with potentially carcinogenic chemical exposures in the workplace, including PAH and benzene exposures (24), a study in Canada (solvents and pesticides;(16)) as well as two in the United States: drycleaning, auto repair, gas station workers,(25) and textile and apparel jobs (26).

Women farmers generally have a lower risk of breast cancer than non-farmers, possibly because of protective reproductive factors such as late age at menarche or vigorous physical activity (18,27). For example, in a recent population-based case-control study, farm women exhibited an overall lower risk of breast cancer than non-farm women. However, in this population, farm women exposed to pesticides were at greater risk of breast cancer (28). This study, the Carolina Breast Cancer Study (CBCS), is the only study that has reported extensively upon environmental risk factors for breast cancer among a sizeable number of African-American women. (Enrollment has recently been completed for the study, which includes over 800 cases and a similar number of population-based controls; currently published papers include approximately 600 African-Americans (300 cases and over 300 controls; RC Millikan, personal communication). Another potential population will be derived from a large scale prospective follow-up study of 64,000 African-American women that is still underway. A major goal is to assess risk factors for breast cancer, of which incident cases are identified every two years through follow-up questionnaires. Limited information on environmental exposures will be available (29).

#### Individual environmental agents, suspected to be mammary carcinogens, and reported risks in African-American women

Ionizing radiation is the most well established environmental risk factor for breast cancer. From groups with very high exposure, it is known that almost all of the excess risk occurs among women who were

exposed during adolescence and who are diagnosed with breast cancer at a relatively early age (30,31). Among survivors of childhood cancer, of whom 68% had radiation therapy, breast cancer was the most common of all second malignancies regardless of gender (32). It also had the longest latency of all second cancers, a median of 16 years after the first cancer. The CBCS found a modest nonsignificant risk among women exposed to ionizing radiation between 10 and 19 years of age (OR 1.6 CI 0.4-7.8); these data were adjusted for race, but separate analyses were not conducted for African-Americans (33). Most studies of workers exposed to low levels of radiation (e.g., weapons facilities), generally over an extended time-period, have not observed an increased breast cancer risk even in the higher ranges of such exposure (15). Admittedly, the failure to detect associations may be attributable to methodological limitations in these studies (15). Pilots and flight attendants have been studied for cancer risk related to excess high-altitude radiation exposure. There were suggestive increases of breast cancer among flight attendants (34,35), but it has been noted that risk factors such as parity may account for these findings (36).

Another environmental exposure that has been frequently examined in relation to breast cancer is electromagnetic fields (EMF). In several studies of male breast cancer, an elevated risk was observed among men employed in either electrical,(37,38) telephone,(39) or railroad (40) occupations that have been linked with higher EMF exposure. Some studies of female workers also support an association between EMF and breast cancer risk (41-43), yet most do not (as reviewed by Caplan et al. (44)). Furthermore, the inconsistent results of studies examining other sources of EMF exposure such as residential proximity to power lines (45-52) or electric blanket use (52-57) do not corroborate a harmful relationship between EMF and breast cancer risk. Thus, to date, the findings have not shown a consistent link between EMF and breast cancer risk. However, as a recent, comprehensive review concludes, the verdict is still not in given that methodological limitations may explain the variation in findings from these studies (44).

Cigarette smoking is not an acknowledged breast cancer risk factor, but there has been sustained interest in its evaluation because chemicals in cigarette smoke are potent mammary carcinogens in rodents and are human carcinogens for other organs (lung, bladder, lymph). Most studies looking at smoking alone as a breast cancer risk factor do not support an overall association,(58-61) including two examining this association in African American women (5,62). Failure to detect an association may be due to the fact that tobacco smoke has been hypothesized to have dual influences on breast cancer risk. It may increase risk by either acting directly as a genotoxic agent or by acting as a promoter, but may reduce risk through its antiestrogenic properties (60,63). These contradictory influences on risk may be dependent on the age or time period of exposure to tobacco smoke (64). Nevertheless, both would be of relevance to breast cancer etiology among African-American women. Genotoxic exposures derived from tobacco use are most likely to be carcinogenic to the breast during early life; this would apply mainly to activity of

chemical components as primary carcinogens, as with ionizing radiation. Animal and in vitro studies strongly support this idea, i.e., that mammary cells at an early stage of development are more susceptible to PAH-induced tumorigenesis (65-67). Epidemiologic studies that have investigated the question have found some hints of elevated breast cancer risk among women who report smoking as teenagers (33,58), as well as among women exposed to passive smoke at younger ages (64) or who actively smoked during their first pregnancy (68).

At later stages of tumorigenesis, smoking may exert an effect by acting as a promoter or by causing mutations in genes related to tumor suppression and progression (Table 1). Postmenopausal women in the CBCS exhibited higher risk if they had been smokers in the past (OR 1.5 CI 1.0-2.4) or in the recent past (OR 3.4 CI 1.4-8.1; adjusted for race and age) (69). In the interim between tumor initiation and progression to malignancy, cigarette smoke may exert its antiestrogenic effects, thereby reducing a woman's risk of breast cancer (64). Thus, ignoring the timing of exposure may obscure the underlying relationship between tobacco smoke and breast cancer risk. Likewise, Morabia et al. observed a positive association between tobacco smoke exposure and breast cancer when the reference group was restricted to women that not only had never actively smoked but that had also never been exposed to passive smoke (70), suggesting that previous studies may have failed to detect an association as a result of unrecognized exposures within their referent group (71-73). Genetic modulation of tobacco smoke exposures is considered below.

Polycyclic aromatic hydrocarbons and heterocyclic amine compounds are among the putative carcinogens in cigarette smoke, and they are also present in foods cooked at a high temperature, in smoked foods, charcoal-broiled meats, and in air pollution. HAA exposures may be derived predominantly from cooked meat. A number of recent studies examined relationships between intake of cooked meat and breast cancer risk; some (74,75) but not all (76,77) studies have found significant associations. Relationships among PAH, HAAs and genetic susceptibility are discussed in the environment-gene section below.

PAH themselves are prototypical mammary carcinogens in rodents (78), but links between PAH exposures and breast cancer, and indeed with other cancers, in humans are not definitive. As with smoking, the possible mechanisms are complex; PAH and their metabolites can be agonists or antagonists in hormonal pathways, making the epidemiologic characterization of risk even more difficult (60). (79) PAH exposure can be estimated via questionnaire or biological measures. Questionnaire assessment of exposure relies on recall of experiences that occurred in the distant past. Unlike HAA, PAH are found in many pollution sources, making accurate exposure assessment complicated. On the other hand, the ability to measure the genotoxic agent (PAH-DNA adducts) in target tissue presents an excellent



opportunity for more precise, objective exposure assessment. However, the lifetime of such adducts is relatively short, requiring the assumption either that the current measure of exposure is indicative of the individual's exposure at the time of carcinogenesis or that exposures are related to late-stage advancement of tumor development. Alternatively, it has been argued that higher levels of such adducts in an individual serve as a biomarker of greater susceptibility (80).

Two separate studies, not among African-Americans, found no relation between PAH-DNA adducts in breast tissue and history of smoking, food intake, or P53 expression (81,82). Such findings suggest a lack of specificity between these sources of exposure and the biomarker of exposure. Two studies that included African-Americans quantified PAH-DNA or aromatic-DNA adducts in breast tissue, but no significant differences in adduct levels were reported by race/ethnicity (82,83). Nor were case-control differences between PAH-DNA adducts in breast tissue significant, adjusting for race, although there was a positive association with breast cancer risk (83). One of these investigations found more adducts in breast adipose than epithelial cells, which may have a bearing on the presumed mechanism of action, i.e. paracrine action (across cell types) vs. autocrine function (direct changes within the cell) (82).

PAH-related mutations have been identified in the tumor suppressor gene P53, which may inactivate the gene's tumor suppressor function and augur for poor prognosis. One of these mutations has been reported to be more common among African-Americans than Caucasians and to have greater geographic variability,(84,85) suggesting an environmental origin (86). However, the largest study of P53 expression in tumors among African-Americans found no differences among three ethnic groups including Caucasians and Hispanics (87).

In addition to assessment issues, repair systems for PAH damage in biological systems are efficient, and thus the associations of PAH-DNA adducts with cancer may be very weak or may be limited to small subgroups of susceptible individuals.

Organochlorines (OCs) are neutral, persistent, lipid-soluble agents that have been widely used as pesticides or electrical insulating fluids. They have potential to enhance or inhibit hormonal actions. As such they may influence tumor development or growth (12,13,88-90). Because OCs are not complete carcinogens, any significant increases in risk conferred by OC exposure may require the presence of other risk factors. Associations between hormonally related risk factors (reproductive history, BMI, progression) and OCs in several studies (91-93) are consistent with late-stage promoting activity by these compounds, the kind of activity they exhibit in biological models (12,14). Similarly, modulation of cytochrome P450 enzymes (or their CYP genes) by OCs leads to alterations in hormone metabolism and to oxidative damage that may contribute to tumor development throughout its timecourse.

Studies over the past 30 years have consistently found OC compounds at higher levels in African-Americans than in Caucasians,(94-96) and this pattern continues today. Levels of bis(4-chlorophenyl)-1,1-dichloroethene (DDE) in African-Americans are approximately twice as higher as those found in Caucasians, with somewhat similar trends for PCBs (Table 3) (92,97-99). Hispanic women also have higher levels of OCs than Caucasian in some reports. Levels of OCs in Caucasian women reported in various studies have declined approximately tenfold since 1970, but not in African-Americans. The tenfold decline is consistent with about three half-lives of elimination accompanied by no further exposure; therefore, African-Americans may continue to be exposed; they may also have longer clearance times attributable to both metabolic capacity and higher BMI (see Context 1 below). Therefore, if there is a threshold dose for breast cancer risk with OCs then the low levels currently seen among Caucasian women may fall below that, while risk may yet be discernible in African-Americans.

A great many reports now exist concerning the relationship of OC exposures to breast cancer risk, mainly with regard to DDE and PCBs, which have been measured in bodily fluids at diagnosis or not long before. The first study to consider African-American women found a non-significantly elevated risk with higher DDE or PCB exposure (98). However, DDE and PCB levels in this study were highest among African-Americans, and the associations of OCs with breast cancer risk were also strongest, compared with Caucasian and Asian women, albeit in a relatively small sample size. The CBCS found that both DDE and PCBs were associated with elevated breast cancer risk among 292 African-American cases and 270 controls (the OR for PCB was statistically significant: OR 1.7 CI 1.0-3.0). There was no association among 456 Caucasian cases and 389 controls (92). Again, in this study levels of DDE and PCBs were higher among African-American women. Most of the case-control studies with the largest sample sizes (>300 cases) have been composed primarily of Caucasian women, and they found no significant associations of individual OC residues measured in blood or adipose tissue with breast cancer risk in the overall population (100-102). Similarly a pooled analysis of 1,400 cases from five studies, primarily Caucasian, found no increased risk for breast cancer with exposure to DDE or PCB, adjusted for race (103). Nevertheless, some studies do find increased risks between one or more OC compounds and breast cancer onset (104-108) or poorer prognosis (93,102).

Associations have been found between organochlorines and breast cancer risk within subgroups that may be related to hormonal factors, including women who had not breastfed,(91) post-menopausal women,(109) and women with the rapid CYP1A1 genotype (110). In the CBCS, where both DDE and PCBs were associated with risk among African-Americans, higher levels of exposure to specific OC compounds were associated with an increased breast cancer risk in certain subgroups of women, including African-American women in the upper tertile of BMI (PCB: OR 4.9 CI 1.6-14.8), African-American women in the lowest tertile of BMI (DDE: OR 3.8 CI 0.98-15.1), as well as African-American

and Caucasian women who were parous but had never breastfed (for both DDE and PCB) (92). Given these observations among African-American women in the CBCS, and their consistency with other studies (91), further investigation may be warranted regarding the effect of organochlorine exposures on breast cancer risk with respect to reproductive milestones, including pregnancy, menopause, and pubertal development (111,112). In addition the higher levels of OCs among African-Americans and their poorer prognosis would warrant investigation of breast cancer incidence, recurrence and survival with regard to hormonally active xenobiotics such as these. Finally, OCs possess a range of hormonal activity, estrogenic, anti-androgenic, anti-estrogenic. Therefore specific mechanisms may be relevant to African-American women whose hormonal profiles have been shown in some studies to differ from Caucasians at different times of life (113-116).

#### Other exposures

Certain solvents and related small molecules including the chloroethylenes are carcinogens in animals and some are mammary carcinogens (Table 2) (117,118). Many of these substances are found commonly in the ambient environment, in public water supplies and around hazardous waste sites. A few ecologic studies have assessed risk for breast cancer with such exposures, although some initial associations have subsequently been suggested to be due to confounding factors (119). In North Carolina, halomethanes in drinking water (chlorination byproducts of water treatment) were quantified by zipcode but were not significantly associated with breast cancer in either African-American or Caucasian women (120). Nitrates in water, an indicator of mutagenic exposures, were quantified on a community basis in Iowa, and associations with some cancers were found, but not with breast cancer (121). In another study, atrazine (a hormonally active herbicide) was quantified at the county level and was associated with breast cancer risk (122). A study of women on Long Island, NY, linking addresses of women in a case-control study of breast cancer to proximate high-traffic sites or chemical facilities having carcinogenic emissions, found a higher risk among postmenopausal women living closer to the sources of exposure (123). In Massachusetts, case-control studies of breast cancer have investigated estrogenic chemical exposures that occurred in previous occupations and tetrachloroethylene contamination of municipal water supplies; no significant associations were found, but there were suggestions of positive associations with tetrachloroethylene (11,124). These studies suffer many of the same shortcomings as occupational studies, including difficulty in adjusting for confounding factors such as reproductive history. In addition, the ecologic studies cannot accurately quantify exposures on an individual basis, leading to imprecisely characterized risk. However, many chemicals including solvents are shortlived in the body and historical assessments are the only way to estimate exposures.

**Factors that act in concert with exposures to link environment with breast cancer etiology and progression.**

Most environmental exposures today either exist at concentrations too low or have carcinogenic potential too weak to be easily identified as risk factors, in contrast with very strong associations between smoking and lung cancer or between radiation and various cancers. Therefore, modifying factors that make some women more susceptible to the effects of environmental agents must be identified in order to elucidate any role of the environment in breast cancer. Exposure assessments and factors that create or influence susceptibility can be examined within several contexts, an approach that may benefit research among African-American women but that would encompass susceptible women of any racial/ethnic group. Four contexts were envisioned by this Workshop as being central to the investigation of environmental agents and exposure modifiers in breast cancer.

Context 1. Environment/environment interactions. Mammary carcinogens may interact with other exposures to increase risk above and beyond the risk associated with each individual exposure. Therefore, epidemiologic research and laboratory investigations must ascertain effects of multiple as well as single exposures advancing the understanding of joint effects. Exposures interacting with one another can have a direct and/or a modifying effect on disease risk. Combinations of exposures have not been well studied because of the biological as well as epidemiologic study design complexities. A major obstacle to the study of joint exposures is the requirement for large numbers of participants with complete risk factor assessments.

Some information on the resultant effect of multiple exposures can be gleaned from laboratory studies with the OCs, where a combination of chemicals has been administered, usually at staggered timepoints, to assess promoter or initiator potential in animal models. The timing of tumor-promoting, tumor-inhibiting, or tumor initiating exposures is critical (125). Examples include dioxin (TCDD, an anti-estrogenic chemical), DDT and PCBs as tumor promoters and PAH or MNU as tumor initiators (12,13,88). Many *in vitro* studies have found effects to be additive (126-128).

Environment/environment interactions may occur between exposures of very different origins, such as chemicals and viruses. Solvents, DDT, TCDD, and PCBs are immunotoxic,(129) and some chemicals of this kind have been implicated as co-factors in hematopoietic cancers that have a viral etiology (14,130), including PCBs and NHL (131,132). Given the recently revived interest in viral etiologies for breast cancer (133-135), investigation of co-factors, such as organochlorines, that may be secondary to viral immunosuppression, could be relevant. Also, by compromising T-cell immune function, organochlorines and other such immunotoxic exposures may serve as late-stage promoters of cancer that originates through other mechanisms.

The examination of joint exposures should take into account endogenous hormones, which are considered carcinogens and which may act as mutagens as well as transcription factors. Hormone levels can be

affected by many factors including BMI, alcohol intake, and diet. Examples can be found in the study of OCs in relation to breast cancer risk. Associations between OCs and breast cancer risk in the CBCS differed according to BMI among African-American and Caucasian women (92). BMI has a major influence on the disposition and metabolism of persistent OCs (136-138). Furthermore, BMI and weight gain are independently associated with post-menopausal breast cancer risk,(139-143) possibly through the elevation of steroid hormones synthesized in peripheral adipose (144). Weight at the time of breast cancer diagnosis (145) and weight gain following diagnosis (146,147) have also been linked to increased breast cancer mortality and recurrence. Moreover, BMI is related to reproductive development, including puberty and age at menarche (148), which have in turn been associated with breast cancer risk (149). Therefore, BMI may affect the bioavailability of OCs as well as hormones in women.

Clearly, research on environment and breast cancer must be incorporated into a larger picture of the complex hormonal milieu that is critical for the development of breast cancer. An individual's hormonal profile is determined by an array of factors encompassing both genetic and environmental influences. Such factors are hypothesized to account for most of the differences between pre- and post-menopausal breast cancer risk, as well as for breast cancer related to family history and early age at diagnosis; risk will likely be better explained by a combination of these factors (150). Environmental/lifestyle risk factors can confer risk that varies among subgroups classified according to hormonal factors. For instance, a stronger association with breast cancer has been reported for higher (versus lower) intake of fruits and vegetables among pre- than post-menopausal women, among women who consume more alcohol than less, and among women with a family history than not (151-154). It is possible that African-American women, and especially those who are at high risk for breast cancer, possess an elevated hormonal profile that may enhance or reduce their response to certain environmental insults, derived from both exposures and from modifying genes (155).

## Context 2. Environment/gene interactions.

Environment-gene interactions have potential to alter the course of carcinogenesis at many steps along the way by mutagenesis and gene regulation. Environment-gene pathways include (1) genes that control Phase I enzymes responsible for converting environmental exposures to mutagenic metabolites; (2) genes that control Phase II enzymes which convert metabolites of environmental toxins to inactive forms; (3) environmental exposures that act as hormone mimics and thus as transcription factors to alter expression of genes; or that can induce gene expression including that of Phase I enzymes. (156,157). A schematic example is shown in the **Figure** for metabolizing genes.

Inherited genetic capacity for metabolism is thought to explain wide inter-individual variations in biological measures of dose, such that even people with comparable exposures can have quite different

internal or target-organ levels. Differences in metabolic capacity may provide quite different susceptibility patterns among African-American women exposed to environmental carcinogens compared to other racial/ethnic groups. Unlike the rare genetic variants (e.g. BRCA1 mutations) typically associated with high risk for cancer, the genome contains numerous more common genetic variants (present at >1-50%), including genes that govern bodily "housekeeping" functions or that indirectly influence metabolic capacity. The idea of individual susceptibility is aptly illustrated by the example of smokers, who do not all experience lung cancer, whereas smoking accounts for much of lung cancer risk. An additional example is that of BRCA gene mutation carriers, among whom it has been estimated that 30% will never suffer from cancer (158).

BRCA1/2 and other high-penetrance genes may have low-prevalence variant alleles that carry a very great risk for subsequent cancer, but they account for little of the overall attributable risk for the disease because inherited mutations exist in altogether less than 10% of the population. When a mutation in one copy of the BRCA1/2 (or P53 or AT) gene is inherited, cancer is thought to ensue only if a somatic mutation occurs in the second copy of the gene, resulting in reduced function as a tumor suppressor or in DNA repair. Because these genes are such powerful guardians of the genome, damage to them may result in short latency (time between exposures and clinically detectable disease) and young age at diagnosis for cancer. Thus, even high-penetrance genes that pose a greatly increased cancer risk may undergo mutations from environmental toxins, protective exposures may prevent these changes.

Studies of genetic variants in metabolizing genes, including the examples in Table 4, have generally reported few or no consistent increases in breast cancer risk with the gene variant alone (110,159). This is not surprising in that the gene variants under study are quite common and that they may affect risk over a long latent period, by acting in concert with relevant exposures, including hormones (160). Compared with the more straightforward and strong (monogenic) risks accompanying BRCA1/2 mutations, carcinogenesis evolving from metabolic pathways requires cumulative, multiple steps, a process that has been termed polygenic (160,161). Studies that have found increased risks with gene variants alone will be discussed along with the gene-exposure findings.

#### Susceptibility— genes that control metabolizing enzymes:

Phase I metabolizing enzymes. Most of the susceptibility genes that have been investigated with regard to environmental exposures can be implicated in cellular oxidative damage that may contribute to the carcinogenic process. Oxidized species, or reactive molecules, are created by Phase I enzyme activation of exogenous agents (Table 2), from endogenous hormones, and from other free-radical sources, such as fatty acid oxidation. Some of the genes controlling this process have higher frequency of the at-risk

variant in African-Americans (Table 4). A general marker of genotoxicity is oxidative damage (ODD) to DNA, for example levels of 8-OHdG and 5HMDU in blood, urine, or tissues. Biomarkers of this kind have shown a much wider variation among African-American than Caucasian women (162). A well-studied research area of oxidative damage involves exposure to PAH, which can be metabolized to the genotoxic PAH diol-epoxide metabolites by P450 (CYP) enzymes; higher levels of the diol-epoxide are found with the more rapid metabolizing Phase I genotype (163). HAAs are similarly activated by NAT. Therefore, if African-American women have high adverse exposures in combination with a greater prevalence of the related adverse genotype(s) then excess risk may ensue; this might be manifest in measures of primary ODD, of tissue damage, or in other diseases related to similar damage. Enzymes of this kind are also involved in uptake and delivery of pain medications, chemotherapy drugs and hormones that may be substrates for several enzymes, e.g. CYP1A1 and CYP1A2. Such variability has been proposed to explain how tamoxifen metabolism differs among racial/ethnic groups, in a way that adversely affects response to tamoxifen among African-Americans (164).

Phase II metabolizing enzymes. Phase II detoxification or deactivating enzymes conjugate genotoxic oxidation products from environmental exposures into readily eliminated metabolites including sulfates, glucuronides, and acetates. If deactivation mechanisms were lower in a subgroup with excessive oxidative damage, then this subgroup might be at increased risk for a number of diseases. A number of examples demonstrate how Phase II enzymes alter individual levels of biomarkers of exposure. Oxidative damage measured as 8-OHdG was highest in urine from neonates whose mothers were both tobacco smoke-exposed and null GST; levels were successively lower in non-exposed with null GST, exposed with GST, and lowest among those with no tobacco smoke exposure who had GST activity (165). Also, women with breast cancer who carried the GST-null genotype had higher PAH-DNA adducts in tissue compared with controls (166), a finding that parallels experiments in cell lines (167). NAT, which can activate HAAs, detoxifies electrophilic intermediates. To illustrate the role of NAT2 detoxification, persons with slow NAT2 phenotypes accumulated higher levels of 3-aminobiphenyl-hemoglobin adducts; among racial/ethnic groups, the average adduct levels were directly proportional to NAT2 slow phenotype, which varied fourfold: 14% slow (Asians; the lowest adduct levels), 34% slow (African-Americans), 54% (Caucasians) (168). These relationships were independent of racial/ethnic status. The combination of GSTM-null with NAT-slow phenotype was also directly related to adduct level (169). With the possible exception of GSTP, in currently published literature African-Americans have not been found to have a higher proportion than Caucasians of null genes for conjugating activity (Table 4).

In epidemiologic studies, more significant findings for the gene variant alone with breast cancer risk have been reported for the phase II deactivating enzymes than for phase I pathways. One explanation could be that there is a temporal advantage in their assessment at later stages of carcinogenesis, perhaps if oxidative damage affects late-stage tumor promotion or tumor suppression. However, there are multiple metabolic pathways that control oxidation processes. Deficiencies in DNA-repair genes and lower intake of dietary antioxidants would also be adverse for risks related to oxidative damage.

Genes that control metabolizing enzymes Most genes related to metabolism (Table 4) are expressed primarily in the liver, so that a carcinogenic effect on mammary epithelium would require that active metabolites be transported to the breast, unless they have an indirect effect such as to raise or lower systemic hormone levels. GST and CYP1A1 are expressed in breast tissue, although the isoforms do not necessarily reflect the known gene variants (170-172)

Phase I metabolizing genes Chemicals of particular interest to breast cancer, including PCBs, DDT, PAH, cigarette smoke, and HAA, can induce some of these enzymes and can be substrates for their own transformation. Among the Phase I enzymes, CYP1A1 is the most well studied. CYP2D6 and CYP2E1 may also be upregulated by or may catalyze the metabolism of environmental agents, including cigarette smoke components, alcohol, and small molecules such as those in Table 2. The at-risk variants in both CYP2D6 and CYP2E1 are uncommon (<10%, Table 4 and reference (173)). Because the prevalence of the known gene variants is low, current epidemiologic studies are too small to detect a gene effect that yields a relative risk below two (174). Pooled analysis of epidemiologic studies indicated that relative risk from the gene variant alone would be less than 1.5 for CYP1A1, NAT1/2, CYP2D6, CYP2E1, and GSTT (174). Hormone synthesis and metabolism are also governed by several Phase I enzymes that can be induced or inhibited by environmental exposures (160). In a mammary tumor model, PAH increased levels of both CYP1B1 and CYP1A1 in normal tissue but only CYP1B1 was increased in tumor tissue (79). Thus xenobiotics may be able to alter the hormone sensitivity of tumors. CYP1B1 metabolizes estrogen (as well as PAH) and the rapid variant is more common among African-American than Caucasian women (175,176). The variant was associated with increased risk for breast cancer among Chinese women (allele frequency 53%)(177), but not among African-American or Caucasian women in another small study (176).

Phase I metabolizing genes: CYP1A1. There are four CYP1A1 variants that have been scrutinized in epidemiologic studies; genotoxic potential is suspected for minor variants that code for more rapid metabolism and that are inducible by various exposures. Two of the identified variants are more prevalent among Caucasians than African-Americans. Another is specific to African-Americans (MSPI-AA), and it has been reported to be more common in African-American women with breast cancer and to be associated with higher levels of adverse estrogen metabolites (178,179). However, the number of patients



was very small, and the findings have not yet been reproduced in other populations of African-Americans. The MSPI variant is more common among Asian women, and it was associated with higher risk of breast cancer in a study in Taiwan,(180,181) while the wild type genotype was associated with early onset breast cancer in Caucasians (182). The CYP1A1\*4 variant conferred a higher risk in another study, especially among postmenopausal women. (183). Other U.S. studies mainly of Caucasian women have found associations for breast cancer among women who smoked before age 18 years who also had two CYP1A1 variants (184). The Ile-Val variant was associated with risk among long-time smokers(185) and among women with higher PCB exposures (186).

Phase I/II metabolizing genes: NAT. The NAT gene family can N-oxidize HAA and related compounds, rendering the rapid form as the at-risk genotype. However, the NATs also conjugate, or deactivate, oxidative intermediates; slow metabolizers would be at risk if this were the exposure of interest. Therefore findings on environment-gene interactions with the N-acetyl transferases are conflicting, but this is not remarkable given the complex, multiple pathways through which these genes may act. The NAT2 and NAT1\*10 rapid genotypes conferred a higher risk for breast cancer among recent smokers in the CBCS (race-adjusted risk estimates); just as the null genotype is rarer, the rapid genotypes are more common in African-Americans than in other ethnic groups (Table 4) (69). A study of Caucasians found a higher risk for breast cancer among smokers with the rapid NAT1\*11 genotype(187). Two studies among Caucasian women found higher risk for smokers who also had low activity NAT2, compared to non-smokers,(188,189) and one of these studies also found higher risk among women smokers who had rapid NAT2 genotypes (189). A third study found nonsignificant raised risk for smokers with low activity NAT2 (190,191)

Because the NAT enzymes activate HAA, they have been investigated in relation to reported dietary intake of cooked meat, although not specifically among African-Americans. One study has found an association between rapid NAT2 or rapid NAT1\*11 and intake of meat or well-done meat (187,192). The same study found increased risk for breast cancer with low activity sulfotransferase alone or with two high activity alleles and higher meat intake (193). Three other reports found no risk associated with NAT2 and meat intake (194-196). In a case-control study on Taiwan, slow acetylators were at higher risk for breast cancer, and this was significant among post- but not pre-menopausal women (197).

Another environment-gene example of Phase II metabolism that deserves further attention is the higher risk observed for breast cancer among post-menopausal Caucasian women with inactive MnSOD genotype, especially those with lower fruit, vegetable and antioxidant intake, consistent with higher oxidative damage (198). This association was not found in a preliminary report from the CBCS, which included African-Americans; further, the frequency of low-activity MnSOD was similar in African-Americans and Caucasians (199). Protection by dietary intake of antioxidants or increased risk from

oxidative exposures may have to be taken into account in addition to the reduced activity genotype, for both Phase I and Phase II enzymes.

Phase II metabolizing genes: GST. The GST family of enzymes conjugates electrophilic substances to their glucuronide metabolites which are biologically inactive and are readily excreted. The at-risk genotype lacks GST activity; known GST-null genotypes are less common in African-Americans than Caucasians (Table 4). GST-null genotypes themselves in most studies have shown no or weak associations with breast cancer risk, either among African-Americans (179,200) or Caucasians (185,200-202). In the CBCS, GSTM and GSTT null genotypes were associated with increased risk among women diagnosed at an earlier age (adjusted for race) or with a family history (200). Among Caucasians one study found null GSTM1 to be significantly associated with breast cancer risk, while GSTT and GSTP null showed positive but non-significantly increased risk (203). Elevated risk was found for GSTP1 null, but not for GSTM1-null, among women with a family history (204). There was also an increased risk for GSTM1-null among older patients in two studies (205,206) and a slightly lower risk of early onset breast cancer in two studies (182,207). However, a pooled analysis indicated that alone, GSTM1 and GSTP null variants confer a modest (<twofold) increased risk for breast cancer (174). Thus in vulnerable subgroups GST-null may pose a risk for breast cancer, perhaps in conjunction with age at onset of cancer or with family history among women with relevant exposures.

Of particular interest for African-Americans, who have poorer prognosis following breast cancer diagnosis, GSTM and GSTT null genotypes were reported to be related to longer survival in a study of 240 cases of Caucasian women (208) although not in a smaller study (209). Moreover, the null variant may be protective against recurrence, by improving response to chemotherapies that result in ODD (210). Because of the lower frequency of null GSTM1 among African-Americans, progression of breast cancer in this population may potentially be related to these genes. On the other hand, studies of GST expression in tissue find no correlation with survival (171,172). Still, these associations are consistent with a possible effect of GST on reducing oxidative damage or opposing other hormonally related oxidative pathways throughout life. Also, early onset, family history, and poor survival are risk patterns that are important for African-American women, but these profiles may also be common to a risk subgroup that responds poorly to oxidative damage; such a group may be characterizable in part by null GST along with other dysfunctional deactivating enzyme profiles, regardless of ethnicity.

DNA repair. Genetic susceptibility to breast cancer following radiation exposure as well as other genotoxic exposures may be related to rare gene variants including germline mutations in BRCA1/2 and AT gene (211,212). Studies of these highly penetrant genes among African-Americans are discussed elsewhere in this monograph. Because the variants in these genes are so rare, research is limited with regard to their interactions with environmental factors. In contrast, a common variant exists in the

XRCC1 base excision repair gene which was associated with increased breast cancer risk among African-American women who had the rare allele (codon 399 gln)(213). Among African-Americans, breast cancer risk was also elevated for women with the homozygous XRCC1 wild-type who had a history of smoking, while among Caucasians the wild-type gene was associated with breast cancer only among women with past exposure to ionizing radiation. The XRCC1 wild-type was associated with higher prevalence of deletions in the P53 gene in breast tumors among African-American women with radiation exposure and more P53 transversions among women who smoked. A number of mutations in the P53 gene have been attributed to environmental exposures (214), and these findings suggest a series of mutations that can arise from environment-gene processes.

#### Oncogenes and tumor suppressor genes:

P53 is overexpressed in approximately 40% of breast tumors, with about 20% having mutations in the gene; these rates are similar among African-Americans, Hispanics, and Caucasians (99,215-217). P53 has many functions, in development, DNA repair, apoptosis, cell cycle regulation, transcription, and as a tumor suppressor (214). Environmental genotoxins have been linked to specific mutations, or hotspots, along the P53 gene, some being characteristic of environmental mutagens such as PAH. The resulting P53 mutational spectrum appears to vary with ethnicity and geographic distribution, consistent with an environmental etiology (4,217). Further, as many as 10 inherited variants have been found in the P53 gene; these differ by race/ethnicity and are possibly associated with risk for breast cancer (174,217-219). Potential evidence for an environmental influence on P53 inactivation is the observation that P53 overexpression of tumors is associated with smoking history, which is consistent with a genotoxic effect of smoking upon P53 (216). In addition, evidence from the CBCS suggested different P53 alterations with smoking versus radiation exposures (213).

The rare HRAS alleles are associated with breast cancer, an association that is possibly stronger in African-Americans (220). Moreover, some polymorphisms in the HRAS gene are more common among African-Americans than Caucasians (219). Environmental exposures have been implicated in HRAS mutations (219,221). A significant positive association between HRAS mutations and breast cancer risk was also seen in a pooled analysis of 9 studies (219).

Transcriptionally active genes. Estrogen receptor (ER) negative breast tumors are implicated in the poor prognosis of breast cancer among African-American women (4). Limited but inconclusive evidence suggests that gene variants in the ER are associated with breast cancer risk (173), although these variants have not been investigated among African-Americans. There are at least two ERs, ER-alpha and ER-beta, which are potentially highly relevant to environmental exposures and are expressed in different tissues (222,223). Hormones and environmental agents have different affinities for the  $\alpha$ - and  $\beta$ -ER. The action

of many compounds including the organochlorines as transcription factors is thought to be mediated through the ER or other hormone receptors, e.g. the androgen receptor (224).

Another transcriptionally active gene (UGTA1A) has a more potent variant among African-Americans; in the CBCS, an elevated risk for breast cancer was found among pre-menopausal African-American women who possessed this variant, with a suggestion of higher risk among women with estrogen receptor-negative breast cancer (225).

In addition, levels of hormone synthesizing and metabolizing enzymes may be induced by environmental substances and thereby alter levels of other exposures. An example is the upregulation of P450 enzymes by drugs, dioxin or broccoli, shifting the ratio of estrogen metabolites in favor of 2-hydroxyestrone over 16 $\alpha$ hydroxyestrone (157,226).

Summary: Individual genes and their targetted substrates have been studied with regard to breast cancer risk, but few studies have included African-American women. Yet most genetic variants exist in all populations, albeit in different proportions. Therefore, the average metabolic profile of racial/ethnic subgroups may be shifted to the degree that variant alleles predominate. Regardless of race, a combined effect of environmental exposures, metabolizing genes, and hormone synthesis and metabolism is suggested by evidence from both experimental and epidemiologic research; compared with other racial/ethnic groups, African-Americans have different distributions of a number of the genes controlling these processes, in particular NAT2- and CYP1B1-rapid alleles. The phenotypic potential, or the overall distribution of such genotypes, holds great promise for identifying an environment-gene or profile associated with breast cancer risk. Future research should also attempt to incorporate a pharmacokinetic-based compartmental approach to exposure assessment that would incorporate pharmacogenetics (i.e. dose-time-gene models) and provide an integrated (time-relevant) dose picture over a woman's lifetime. Dietary intakes are also important to consider with metabolizing enzymes, particularly antioxidants which, with detoxifying enzymes, may reduce oxidative damage and thereby alter both transcriptional and mutagenic effects of environmental agents.

Concept 3. Environment/social interactions. Environmental epidemiologic research has generally disregarded the fact that environmental exposures are intimately entwined with social, behavioral and psychosocial factors. Statistical models usually include socioeconomic status (SES) and race/ethnicity, but SES is measured rather crudely, for example by annual income or educational level. Research has suggested that SES accounts for much of the racial/ethnic variability in breast cancer incidence or mortality (227). Both of these factors should be considered in order to obtain a more complete picture of breast cancer risk in the U.S. (228). Other investigators feel that geographic differences in breast cancer

mortality can be explained by reproductive factors and lifestyle variations across various regions in the U.S. (113,229). Further, it has been proposed that two socially influenced factors play an important role in breast cancer risk: tissue susceptibility brought on by reproductive factors such as early menarche and higher exposures to carcinogens (230).

The concept of environmental justice has emphasized the idea that higher exposures to toxic exposures often exist in underserved populations, and these populations also contain a disproportionate number of minority groups, including African-Americans (231). An environmental justice approach would suggest that SES and reproductive factors may be responsible for higher levels of OCs seen in African-American and Hispanics (221). Type of housing, its upkeep and geographic location can dictate kinds, number and levels of exposures. In addition, stress can arise from poverty and other inadequacies in quality-of-life, and these may render such individuals more vulnerable to adverse effects of exogenous exposures (232). For example, stress may compromise immune function through a psychophysiological mechanism or secondary to infectious diseases that arise from psychosocial stress or indigence (233,234). This, in turn, may increase risk for breast cancer from environmental exposures that lower immune response. It has been said that the kind of tumor may represent socioenvironmental exposures (155). Therefore, the environment-social context into which environmental exposures are incorporated can describe a biobehavioral environmental model for breast cancer risk, and this context would include socially vulnerable subgroups regardless of racial/ethnic status (232).

#### Context 4. Temporal effects, or timing of environmental risk factors

The biological sequence of events leading to cancer no doubt coincides with certain times of vulnerability during life and latency for cancer (Table 1). Much epidemiologic and experimental evidence suggests the need to investigate mutagenic exposures that occur at young ages in a woman's life, even *in utero* (235). Studies of breast cancer suggest that the intrauterine environment, age at menarche, age at first birth as well as the interval between these latter two events may be critical periods in breast cancer development (236,237). For example, being a twin or being heavier at birth appears to increase breast cancer risk while maternal preeclampsia or breastfeeding decreases risk in the daughter (237). To reiterate examples given earlier in this paper, ionizing radiation and cigarette smoke are purported to exert a primary carcinogenic effect relatively early in life, whereas immunotoxic or tumor promoting activity may support later stages of tumorigenesis.

Russo and Russo and others have argued that the peripubertal and early post-partum periods are highly likely periods for tumor initiation to occur (65,125). It has also been suggested that exposures following menarche but prior to first pregnancy are more detrimental because the breast cells are undergoing differentiation and proliferation during this interval and are therefore more vulnerable to carcinogenic

exposure (238). Experimental research has established that tumor initiation is most effective during early breast development (65,125,221,239). In vitro studies further suggest that mammary epithelial cells from virgin rats produce more mutagenic PAH metabolites than do cells from pregnant rats (67). In addition, in laboratory studies, perinatal exposures can alter ductal and lobular development within the breast (240). Little research in humans has been done in this area.

Age at puberty is about one year earlier among African-Americans (241), and age at menarche has been consistently younger than among Caucasians during this century by approximately one-half year (113,241). This has potentially great impact for cancer risk, because early menarche may explain, in part, the higher rates of pre-menopausal breast cancer among African-American women compared with Caucasian women in the United States (242,243). As suggested earlier, a younger age at puberty and menarche could provide a longer period of vulnerability to insult by environmental carcinogens upon the breast tissue. Studies have identified some environmental exposures that influence age at puberty and/or menarche as well as other factors associated with reproductive function (such as cyclicity and fecundity). In animals a large number of chemical exposures alter onset of puberty (vaginal opening) (244,245). In support of this experimental data, Gladen et al. (112) find a positive association among girls with in utero exposures to PCBs and weight during puberty, although not with pubertal stage. Caucasian girls exposed to higher versus lower levels of polybrominated biphenyls in utero experienced an earlier age at menarche (111). No comparable data exist for non-Caucasian children. Chemical exposures have also been seen to be associated with menstrual function during the reproductive years (246). In addition, cyclicity and age at menopause have been linked to stress as well as smoking and this has been observed in African-American women (247). Rogan and colleagues have observed a shortened duration of lactation among women with highest exposures to DDE (248,249). Because long duration of lactation may be protective for later breast cancer, these findings offer an additional mechanism by which environmental exposures may alter risk for breast cancer many years before breast cancer diagnosis.

Research is needed to identify environmental exposures experienced in early life that may affect breast cancer risk (4). These exposures may affect tumorigenesis only indirectly, making risk ascertainment very difficult. Therefore, research efforts should be directed toward how environmental exposures may alter known risk factors, including timing of puberty/menarche, menstrual function, fecundity, lactation, and age at menopause. As reviewed in the paper by L. Bernstein in this monograph, early life and other reproductive factors among African American women, as well as among other racial/ethnic groups, confer risk for breast cancer (generally less than two-fold). Because breast cancer risk may vary depending on the timing of exposure, future examination of environmental risk factors should take into consideration the age or time period in a woman's life these exposures occur.

**Resources are needed to be able to effectively link environment with breast cancer etiology and progression**

Efforts need to be made to identify resources for undertaking research on the role of environment in breast cancer, both populations available for study and methodologies to assess multiple risk factors. Opportunities should be developed that will enable research to be undertaken within the contexts of environmental etiologies discussed above. A number of general as well as specific opportunities were suggested by the Environmental Working Group.

- Large populations can be combined to enhance existing studies. Future studies must include African-American women or must identify susceptible or vulnerable subgroups. Attempts to pool existing and future data, biological samples, or other population resources should be made in order to elucidate risks that affect African-American women. Newly funded studies should collaborate in the early stages of the research so that data collected can be effectively combined in later analyses.
- Studies should be undertaken among highly exposed or uniquely exposed women, including occupations and industries with intense exposures to carcinogens or hormonally active agents; migrant groups that can elucidate the role of migration and acculturation; uniquely exposed groups, such as migrant farm workers (pesticides) and populations living on /near environmental justice/superfund sites; male breast cancer, to determine risk factors among blacks (250).
- Focus-groups may help identify new exposures and appropriate contexts for assessment of risk.
- Groups of women with early onset breast cancer would enable researchers to assess differing risk factors in such women, but also it would be possible to then examine risk in sisters, mothers and daughters (and sons!) of the affected women.
- Registries of affected persons exist already for special studies; environmental assessment could be added on to existing studies of African-American women (at least five or six such efforts could be identified by the Workshop).
- Research should be encouraged that will develop better tools for exposure assessment and for ecologic, occupational, cohort and case-control studies.

In line with the theme that etiologic and prognostic factors are useful only as they are generalizable, newly identified population resources must preserve the ability to study individual populations while enabling the results to be linked to other research. Efforts must continue to implement existing recommendations that are particular to breast cancer in African American women. Examples are recent

reports from the Institute of Medicine on Cancer in Minorities and on Gender Differences in Susceptibility to Environmental Factors (251).

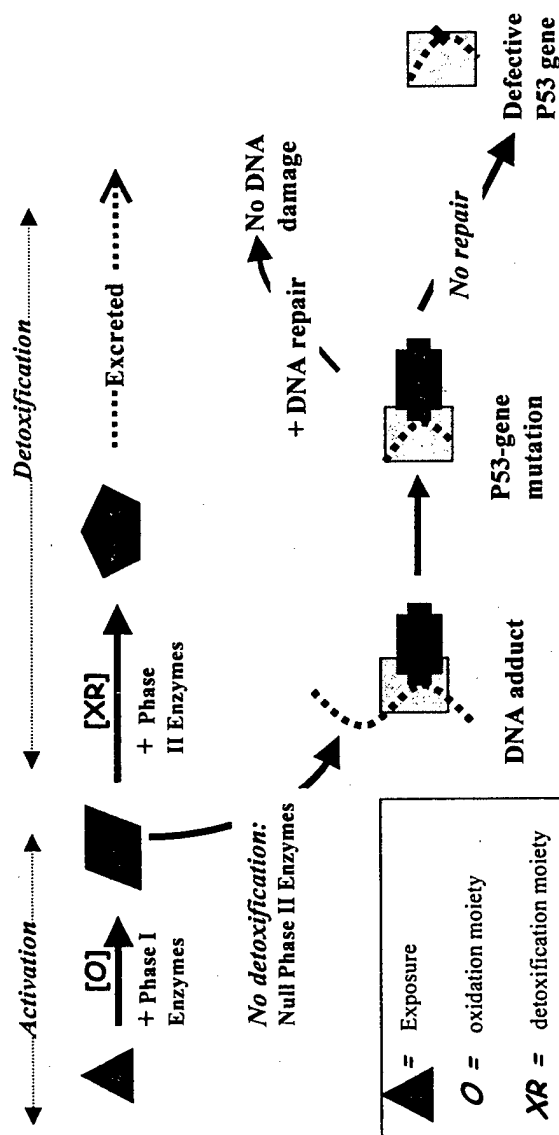
### **Summary and conclusions**

Evidence suggests that environmental factors and genetic susceptibility are associated with breast cancer risk, although there is a paucity of research among African-Americans. Relative to Caucasians, African-American women as well as women of other racial/ethnic minorities may have higher levels of exposures to certain environmental agents implicated in breast cancer risk. They may also have greater genetic susceptibility to the biological effects of such exposures. When possible, future studies should include women of all racial/ethnic backgrounds in order to elucidate environment-gene as well as social factors in breast cancer etiology. Additionally, research should consider how genetic, social and environmental factors act within the complex hormonal milieu that leads to the development of breast cancer.

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Figure: Schematic that might represent DNA damage by an environmental toxin resulting in a P53 mutation



**Table 1: Mechanistic basis for action of environmental agents in breast cancer**

Gene regulated process with potential for environmental modulation	Step in carcinogenesis	Putative environmental exposure	Probable time of life
Mammary cell development and differentiation	Susceptibility to premalignant changes	-Chemicals <i>in utero</i>	Perinatal
Oxidation, cell turnover	Formation of Procarcinogen	-Modulation of gene expression -PAH epoxide, viral damage	Peripubertal
Detoxification	Gene mutation (DNA adduct)	-PAH-epoxide, free radicals -Modulation of gene expression	Lifetime
DNA repair	Clonal expansion, oncogene mutation	P53 mutations by PAH	Lifetime
Growth, tumor promotion	Tumor growth, tumor recurrence	-DDT, phorbol esters, DES? -Modulation of hormone metabolism	Young adult
Tumor progression	Tumor aggressivity, metastasis	Dieldrin?	Middle Age
	Metastasis		

**Table 2: Known mammary carcinogens in rodents**

\*Benzene, butadiene

\*3-MC, DMBA, aromatic amines

\*EDB, VC, CCl<sub>4</sub>, CH<sub>2</sub>Cl<sub>2</sub>

\*MNU and analogs

+DES, E2

\*-Mutagenic agents    +-Hormonal agents

Adapted from references (7),(8) and (252). Abbreviations: EDB - ethylene dibromide; VC- vinyl chloride; CCl<sub>4</sub> - carbon tetrachloride; CH<sub>2</sub>Cl<sub>2</sub> - dichloromethane; DES - diethylstilbestrol; E2 - estradiol; MNU - methylnitrosourea; 3-MC - 3-methylcholanthrene; DMBA - dimethylbenzanthracene

**Table 3. Comparison of organochlorine levels in African-Americans vs Caucasians**

	African-American			Caucasian			basis	Ref
	DDE	PCB	N	DDE	PCB	N		
FL, 1960's*	13	-	70	8.2	-	64	whole	(94)
SC 1968-rural*	11	0.3	>100	3	2.3	>100		(96)
SC 1968-urban*	6	1.9	>100	3	3.1	>100		
CA, 1964-71*	43	4.5	50	35	4.2	50	whole	(98)
NC, 1993-96*	1690	510	270	760	380	389	lipid	(92)
NYC, 1994-7*	1000	800	69	550	650	193	lipid	(99)
CT, 1994-97*	1930	-	<100	917	-	<100	lipid	(97)

Parts per billion, means or geometric means, among non-cancer subjects\* or among control subjects\* in recent studies. Lipid basis is approximately 200-whole serum in most reports.

**Table 4: Examples of genes that modulate environmental agents: prevalence (%) of variants**

			African-American	Caucasian
		Reference	Range of reported values	
Phase I metabolizing genes	CYP1A1, MSPI (wt/var; wt/var)	(159) (211) (182)	13-31%; 3-5.8%	21-39%; 2-5%
	CYP1A1, Ile-Val (wt/var; wt/var)	(253) (211) (182)	3.7-4.4%; 0%	9-15%; 1.1%
	CYP1A1, MSPI-AA (wt/var; wt/var)	(253) (211)	15-20%; 0-1.9 %	0%; 0%
	CYP2E1 (2 sites, allele frequency)	(252)	0.02-0.09	0.02-0.08
	CYP1B1 rapid, gene frequency	(175,176)	70-75%	35-40%
	NAT1*10 rapid	(254)	76%	38%
Phase II conjugation/ detoxification genes	NAT2 <sup>0</sup> (null; 4-7 alleles)	(254,255), (256)	40-64	56-74
	GST-M <sup>0</sup> (null)	(159) (254) (252)	13-41%	52-62%
	GST-T <sup>0</sup> (null)	(159) (254) (252) (257)	17-29%	16-27%
	GST-P (val/val)	(254)	23%	11%
DNA repair gene	XRCC1 (cod399 gln allele frequency)	(213)	0.14	0.36
Tumor suppressor, repair, etc.	P53 2-1-2 haplotype 1-2-1 haplotype	(258)	37% 32%	78% 9%

Data from breast cancer studies are from controls where information was available.

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## EXPERIENCES OF RACIST EVENTS HAVE NEGATIVE HEALTH CONSEQUENCES FOR AFRICAN AMERICAN WOMEN

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Although a considerable literature indicates that negative life events have adverse effects on psychological adjustment and physical health, little research has examined the impact of experiences of racism among African Americans. We hypothesized that individuals reporting more experiences of racist events (past year, life time) on the Schedule of Racist Events (SRE), would have higher levels of: psychological distress (Brief Symptom Inventory), negative health behaviors (smoking, drinking), and health problems (perceived health, frequency of common colds). Participants were 71 African American women (mean age 44.4) who completed the SRE as part of a larger longitudinal study on familial risk of breast cancer. Results indicated that racist events experienced in the past year were positively related to: psychological distress ( $p < .01$ ), number of cigarettes smoked in the past 4 days ( $p < .05$ ), number of alcoholic drinks consumed in the past 4 days ( $p < .01$ ), and the frequency of common colds ( $p < .01$ ). Lifetime experiences of racism were positively related to: psychological distress ( $p < .001$ ), and frequency of common colds ( $p < .01$ ), and negatively related to the women's perceptions of their own health compared to others ( $p < .05$ ). These results highlight the potential detrimental effect of racism on African American psychological adjustment and physical health and suggest that these variables should be targeted in health research and interventions. The study was supported by grants from the NIH (CA72457) and the DOD (DAMD17-99-1-9303).

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East Harlem Partnership for Cancer Awareness (EHPCA):  
collaborative cancer screening and prevention research  
in an urban minority community

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## Background

From 1992 through 1998, cancer incidence rates for all sites combined decreased within the U.S., primarily because of a decline of 2.9% per year in White males and 3.1% per year in African American males; in addition, cancer mortality rates declined 1.1% per year, with the greatest decrease among African American males (Howe, et al, 2001). For 1994-1998, according to the Surveillance, Epidemiology and End Results program (SEER), breast, prostate and colorectal cancer represented 42% of cancer incidence and 24% of cancer deaths in the U.S. (Ries, et al, 2001). While the decline of overall cancer incidence and death rates indicates improvement, such progress is not universal. As of 1998, cancer deaths among the three largest ethnic groups are as follows: 255.1/100,000 for African Americans; 199.3 for Whites; and 123.7 for Hispanics (CDC, 2000). A major goal of Healthy People 2010 is to eliminate health disparities among segments of the population, including differences related to gender, race or ethnicity, education or income, disability, geographic location or sexual orientation (Health and Human Services, 2000). The burden of cancer, in particular, remains unequal among ethnic, gender and socioeconomic groups and the reduction of incidence and mortality among all populations a priority identified by the National Cancer Institute (2001). The underserved, i.e., low-income status, minorities, and the elderly, are target populations for cancer control interventions (NCI, 2001). The two largest ethnic minorities in the U.S. are African Americans and Hispanics, both groups having sizable populations in the lower socioeconomic strata and falling into the categories of underserved and high risk populations (U.S. Census, 2000).

### African Americans and Cancer

The year 2000 U.S. Census estimates the African American, non-Hispanic, population of the U.S. to be 34.7 million, representing 12.2% of the total and a growth of almost 16% from

1990 (U.S. Bureau of the Census, 2000). In spite of recent improvements in both incidence and mortality, African Americans continue to have the highest age-adjusted cancer incidence and mortality rates of any population group in the U.S. (Landis, et al., 1998), with late diagnosis of breast, prostate and colorectal cancers contributing to higher mortality (Austin, et al., 1990).

### Breast Cancer

Breast cancer is the most common cancer diagnosed among women in all five racial and ethnic populations (Howe, et al, 2001), with 184,200 new cases diagnosed in the year 2000 and 40,800 deaths (Healthy People 2001). While White women are more likely to develop breast cancer, incidence rates in African American women under 40 exceed those of White women (NCI, 2001, Trock, 96). In addition, African American women are more likely to die of breast cancer than are women of any other racial or ethnic group, with overall mortality rates greater in African American women (35.7 per 100,000) than White women (27.3 per 100,000) (CDC, 1998). Breast cancer is the leading cause of cancer mortality in African American women (NCI, 2001). African American women are more likely to be diagnosed at an advanced stage of breast cancer and experience survival rates significantly lower at all stages of disease (Jacob, Spieth & Penn, 1993; Boring, Squires, & Heath, 1992). Presentation of a more advanced stage at diagnosis has been attributed to lower use of mammography, after controlling for income and access to care, as well as delay in seeking treatment, behaviors which reflect a number of socioeconomic, behavioral and cultural factors (Trock, 96).

### Prostate Cancer

In 2000, 180,400 new cases of prostate cancer were diagnosed (Healthy People 2010). As of 1998, prostate cancer was first in incidence and second to lung cancer as the most common



cause of cancer death among men across all five racial and ethnic populations, with 32 deaths per 100,000 men (CDC, 2001).

African American men have the highest prostate cancer incidence and mortality rates of any racial/ethnic group (Ries, et al, 2001): incidence of 234.2/100,000 compared to 144.6 for Whites and 103.4 for Hispanics; 53.1 deaths/100,000 compared to 22.4/100,000 for White men and 15.9/100,000 for Hispanics (ACS,2002). This disparity continues to increase, with prostate cancer rates 39% higher among African Americans ages 65 and older compared with White men in the same age group (Ries, et al, 1999; Collins, 1997). Additionally, African American men 60 and under present with higher grade and later stage of tumor and have only a 4-year median survival, compared to 6 years among Whites (Collins, 1997).

#### Colorectal Cancer (CRC)

In 2000, it is estimated that 130,200 people were diagnosed with colorectal cancer (CRC) and 56,300 died from it, a mortality rate of 21.2/100,000 (CDC, 2001). SEER data for 1994-1998 indicates colon cancer is the second leading cause of cancer death overall (Ries, et al, 2001). From 1973-1994, incidence trends for CRC showed a 7.6% decrease for Whites to 42.9/100,000 but a 22.5% increase among African Americans to 50.1/100,000 (ACS,2002; Baquet & Commiskey, 1999). During the same period, U.S. mortality rates for CRC decreased almost 22% for Whites to 16.8/100,000 compared to a 9% increase for African Americans to 22.8/100,000 (ACS, 2002; Baquet & Commiskey, 1999). While incidence is higher in men than in women for both races, CRC is the third most common cancer among women, with a mortality rate for African American women similar to the overall rate for men (20 per 100,000 vs. 21.5 per 100,000) (Ries, et al, 2001). The incidence rate for African American women is 20% higher than for White women, and the mortality rate is 39% greater (Ries, et al, 1999). African American

race, female sex, and low SES have been reported to be related to stage of diagnosis of colorectal cancer, with SES the most important determinant (Mandelblatt, et al, 1996).

Such disparities in mortality rates for CRC may be due to differences in stage, comorbidity, access to health services, possible differences in disease biology, or in knowledge, attitudes, or beliefs about cancer (Tilley, et al, 1997; Powe, 1995).

### Hispanics and Cancer

According to the year 2000 U.S. Census, there are approximately 35.3 million Hispanic-Americans of any race residing in the U.S., representing 12% of the total population (U.S. Bureau of the Census, 2000). This indicates a 58% rate of growth in the Hispanic population from 1990, making Hispanics the fastest growing ethnic minority in the country (U.S. Bureau of the Census, 2000). "Hispanic" is commonly used to indicate people with familial roots in Latin America, the Caribbean or Spain (Marin & Marin, 1991). Hispanics in the U.S. are a heterogeneous group, with a wide variety of nations of origin and socio-demographic characteristics, including education, family income, and levels of acculturation varying by subgroup (Naranjo, 1998; Canales, 1995).

Cancer is the second leading cause of death among Hispanics, after heart disease (ACS, 2000). While experiencing substantially lower incidence and mortality from all cancers combined, Hispanics have a higher burden of cancers of the stomach, liver and cervix (NCI, 2001).

### Breast Cancer

Breast cancer, the most frequently diagnosed cancer among Hispanic women, is diagnosed at a later stage than among non-Hispanic White women, with an incidence rate of

68.5/100,000(ACS, 2002; Chen, et al, 1994) and is the leading cause of cancer death among Hispanic women, with a mortality rate of 14.8/100,000 (ACS, 2002).

#### Prostate Cancer

While lower than for White or African American men, prostate cancer is number one in cancer incidence in Hispanic men with a rate of 103.4/100,000 and a mortality rate of 15.9/100,000 (ACS, 2002). Advanced stage prostate cancer rates for Hispanics are 4.2% higher than for non-Hispanic White men (Hoffman, et al, 2001).

#### Colorectal Cancer

Current rates of CRC incidence among Hispanics are 35.2/100,000 for men, making CRC the third most common cancer in Hispanic men, and 23.2/100,000 for women, second in incidence for Hispanic women (ACS, 2002). The incidence of colorectal disease is on the rise among Hispanics, which may reflect increased acculturation and adoption of a more western diet (Lipkus, et al, 1996). Mortality rates are 13.0/100,000 for men and 8.0/100,000 for women (ACS, 2002).

#### Cancer Screening

In light of the difficulty in identifying the causes of cancer or in affecting behavioral change to decrease cancer incidence, cancer screening is strongly recommended by the CDC (2001). As a secondary method of prevention, cancer screening promotes early diagnosis and treatment (Harvard Report on Cancer Prevention, 1999). The most dramatic success story in cancer screening has been realized in terms of mammography. According to the National Health Institute Surveys from 1987, 1991 and 1998, mammography use almost doubled; by 1998, 67% of women over 40 had a mammogram within the last 2 years with no difference in screening utilization between African American and White women, though elderly

African American women had a lower rate of regular mammography utilization (Lee & Vogel, 1995). Hispanic women had only a 60% rate of mammography (U.S. Dept. of Health & Human Services, 2000), with factors relating to mammography varying among Hispanic subgroups (Ramirez, et al, 2000). Having a regular doctor and breast cancer screening knowledge have been identified as significant factors in mammography screening among low income, low education Hispanics (Valdez, et al, 2001). Of particular concern are indications that Hispanics have the lowest level of appropriate cancer screening behavior among major ethnic groups (Womeodu & Bailey, 1996).

Hoping to build on mammography success, Healthy People 2010 has a goal of increasing the proportion of physicians who counsel patients regarding cancer screening in a linguistically and culturally appropriate manner (U.S. Dept. of Health & Human Services, 2000).

The following recommendations by the American Cancer Society (ACS, 2001) are widely, though not unanimously, advocated by health care professionals for people of average risk:

#### Breast Cancer

Screening mammogram every year for women aged 40 and older; clinical breast exams every 3 years for women between 20 and 39 and annually thereafter; and breast self-examination (BSE) every month for women aged 20 or older.

While definitive results continue to be debated and investigated, regular mammography has been credited with reducing cancer mortality by about 16% for women 40-49 years old and 25-30% for women 50-69 (Kerlikowske, 1997) and continues to be recommended by the CDC as a means of reducing breast cancer deaths (CDC, 2001).

#### Colorectal Cancer beginning at age 50:

- annually, a Fecal Occult Blood Test (FOBT) which detects hidden blood in feces.  
The test is performed at home and returned to the doctor's office or laboratory and
- every five years, Flexible Sigmoidoscopy (FS) in which a lighted tube inserted through the rectum allows inspection of the lower part of the colon or
- every five years, Double Contrast Barium Enema (DCBE) through which barium sulfate is spread throughout the colon, providing pictures of the lining of the colon or
- every ten years, Colonoscopy in which a colonoscope is inserted through the rectum into the entire colon. At the same time, polyps, which may be pre-cancerous, can be removed. (Colonoscopy is also the recommended follow-up to all other screening at which positive results are indicated).

Having flexible sigmoidoscopy (FS) within the past 10 years has been shown to be associated with a 70% reduction in the risk of colorectal cancer (Selby, et al, 1992). White men and women are more likely to adhere to FOBT guidelines than African American or Hispanic men or women (Breen, et al, 2001), although currently less than 50% of people over age 50 in the three major ethnic groups adhere to the recommended guidelines for FOBT or FS (Bolen, et al, 1997). The percentage of CRC screening over age 50 is: 38.7% for Whites, 31.5% for African Americans, and 23.7% for Hispanics (Dept. of Health and Human Services, 2000).

Healthy People 2010 targets for CRC screening are 50% of the population having FOBT within the past 2 years and 50% having had a previous sigmoidoscopy (U.S. Dept. of Health and Human Services, 2000).

#### Prostate Cancer

Efforts aimed at decreasing deaths from prostate cancer through screening and early detection are controversial because of the uncertain benefits of treatment versus no treatment (CDC, 2000). The ACS continues to recommend a Prostate-specific Antigen blood test (PSA) annually, along with a digital rectal examination (DRE), for men over 50 with at least a 10-year estimated life expectancy. Also, due to their increased risk, it is recommended that African American men begin screening at age 45. The National Health Interview Survey (NHIS) shows Hispanic men over 40 years having the lowest rate of DRE of the three main ethnic groups (Centers for Disease Control and Prevention, 1995); additionally, African American and Hispanic men present with advanced-stage prostate cancer more than non-Hispanic Whites (Hoffman, et al, 2001).

#### Cancer Screening Barriers

Ethnic minorities face a number of barriers to accessing health care. These barriers fall into three broad categories: sociodemographic (income, education, lack of health insurance/inadequacy of health insurance) (Womeodu & Bailey, 1996; Harper, 1993; Marks, et al, 1987); acculturation (language preferences, fear and distrust, few ethnic role models advocating intervention) (Gregg & Curry, 1994; Lantz, et al, 1994), culture-specific beliefs and practices (Womeodu & Bailey, 1996); and insufficient provision of preventive health care information (Michielutte, et al, 1999). Other barriers which may exist are not known due to the limited research in which minority participants have been included (Baquet & Commiskey, 1999).

#### Sociodemographic barriers

Minority status is often associated with lower levels of education and related lower occupational status and income (Hegarty, et al, 2000). Groups with low income and low education have a decreased prevalence of cancer screening across age groups (Breen, et al, 2001;

Smith, et al, 1997). Resulting financial constraints can limit access to services through inadequate health insurance coverage or lack of money for out-of-pocket health care (Hegarty, et al, 2000; Zimmerman, 1997; Price, 1993). As a result, minority group members are less likely to seek preventive care or screening tests, and are more likely to rely on emergency rooms for routine health care, the utilization of which may pose an additional barrier due to the lack of established physician-patient relationships or emphasis on preventive medicine (Hedegaard, et al, 1996; Martin, et al, 1996). The lack of a physician-patient relationship and obtaining less routine clinical care place men, in particular, at an increased risk of poor screening practices (Womeodu & Bailey, 1996; Chao, et al, 1987). Physician recommendations have been shown to be predictors of breast cancer and colon cancer screening (Mandelson, et al, 2000; Clavel-Chapelon, et al, 1999; Rakoski, et al, 1998; Lipkus, 1996; Skinner, et al, 1997). Physician recommendation for mammography screening has also been shown to have a linear relationship to socioeconomic status and age, with physician recommendations decreasing as women's income decreases and age increases (O'Malley, et al, 2001; Brenes & Paskett, 2000), a particular concern in light of elderly minority women having low screening rates relative to their high risk (Fox, et al, 2001). Related economic barriers to health care include: the need for child care, inadequate transportation, and loss of pay while obtaining care related to restricted hours of operation of health care facilities and limited availability of sick leave (Clavel-Chapelon, et al, 1999; Zimmerman, 1997; Breen, et al, 1996).

Economic barriers do not fully account for disparities in health care utilization and disease outcomes between Whites and ethnic minority members. Race plays an important role in cancer detection and prognosis. Hispanic participants in a large health maintenance organization were found less likely to have completed a fecal occult blood test (FOBT) or sigmoidoscopy than

non-Hispanic whites (Perez-Stable, et al, 1994). Not only do African Americans and Hispanics have a low rate of participation in cancer screening for all types of cancer, they delay seeking treatment after detecting a symptom (Kerner,1995). Therefore, they are more likely to have cancer diagnosed at a later stage of disease than non-Hispanic whites (Lipkus, et al, 1996) and, consequently, may have a shortened survival time.

### Acculturation Barriers

Culture-specific attitudes, particularly fatalism, have also been found to be associated with lower levels of health care use among both African Americans and Hispanics (Chavez, et al, 1997). Higher fatalism, that is, disbelief in the value of early detection and treatment coupled with the belief that death is inevitable when cancer or the potential for cancer is present (Lantz, et al, 1994), has been associated with lower mammography and CRC screening (Chavez, et al, 1997; Suarez, et al, 1997; Powe, 1995). Acculturative barriers include traditional beliefs about the causes of disease (e.g., cancer is caused by “bad blood” or “evil spirits”); inaccurate self-estimates of risk (Borrayo, et al, 2000; Weinrich, et al, 1998, Lipkus, et al, 1996; Anderson, et al, 1995); and cancer prevention being viewed as ineffective or nonexistent (Peragallo, et al, 1998). Among Hispanics, level of acculturation is strongly associated with language. Lack of proficiency in English hampers acquisition of knowledge about health risks and ability to communicate with health care providers (Suarez, et al, 1997). Length of time residing in the U.S. increases adherence to mammography screening (Blackman, et al, 1999). Highly acculturated Hispanics have been shown to have similar cancer related knowledge and risk behavior as non-Hispanic Whites (Suarez & Pulley, 1995), including the practice of BSE (Peragallo, et al, 2000), and less acculturated Hispanics exhibit a more fatalistic attitude about cancer as being unpreventable and a death sentence (Perez-Stable, 1992). Such attitudes may be



related to Hispanics receiving less cancer screening, including mammography, Papanicolaou (Pap) test, PSA and sigmoidoscopy (ACS, 2000).

#### Insufficient provision of cancer prevention information

There is evidence that minorities do not get the same level of preventive care information as non-minorities, and that medically underserved minorities in general have less knowledge about cancer than Whites. Michielutte, et al (1999) have argued that differences in knowledge are due to different means of obtaining information through the media, different levels of education and a reduced ability of minority group members to obtain knowledge about cancer related to less access to medical care. For example, African American men perceive their primary care physicians as providing little, if any, information about prostate cancer during the medical visit (Smith, et al, 1997). A recent study in Central Harlem, New York, found low levels of knowledge among African American men regarding prostate cancer risk (Ashford, et al, 2001). In addition, cultural and language differences between patients and providers may limit understanding and sensitivity of health care providers. Fears about screening, embarrassment, and concern about pain or discomfort (Hedegaard, et al, 1996; Frazier, et al, 1996; Pearlman, et al, 1996) may be related to inadequate communication regarding screening procedures and benefits. Additionally, information needs may vary for those who have never had cancer screening versus those who have but may not be aware of screening guidelines (Valdez, et al, 2001).

In summary, ethnic minorities experience increased risk of cancer incidence and mortality related to lack of knowledge regarding cancer prevention and screening. Such lack reflects multifactorial barriers including low socioeconomic status, institutional barriers to health care and issues of acculturation. Community based interventions are a recognized approach to

improving the health status of these special populations (U.S. Dept. of Health & Human Services, 2000). Rather than impose interventions on the community, it is preferable for community-based interventions to come from and be for the community in order to meet documented needs in an effective, culturally-appropriate way (Navarro, et al, 1998). With this as a guiding principle, the East Harlem Partnership for Cancer Awareness (EHPCA) was established in order to address such barriers to cancer prevention and screening in an urban, medically-underserved community.

#### The Partnership

EPHCA is a collaboration between the Mount Sinai School of Medicine, Metropolitan Hospital Center, Boriken Health Center and Settlement Health, and was formed in April 2000 to address a serious public health issue: the disproportionate rates of cancer among the predominantly Hispanic and African American residents of the East Harlem, New York community. Indeed, the incidence and severity of prostate and colorectal cancer among adults ages 45-64 living in this community are significantly higher than the average for New York City. Although the incidence rate for breast cancer among women ages 45-64 is actually lower in East Harlem than the average in New York City, women in East Harlem are diagnosed with breast cancer at later stages of the disease. Malignant neoplasms are the second leading cause of death in East Harlem, with an age-adjusted rate of 187.8 per 100,000, higher than the average for the rest of Manhattan (NYC Dept. of Health, 1997).

The objective of the Partnership is to develop educational strategies to reduce barriers to screening for cancer in minority and other disadvantaged populations of East Harlem, as outlined in the Mission Statement:

The East Harlem Partnership for Cancer Awareness (EHPCA)  
was established to increase the rates of cancer screening among

African American and Latino residents of East Harlem and other urban medically underserved communities where screening rates are low and disparities in the incidence of cancer are great. The Partnership brings together community leaders, public health professionals and researchers in cancer prevention for the Mount Sinai School of Medicine, Metropolitan Hospital Center, Boriken Neighborhood Health Center and Settlement Health Center. The primary goal is to increase participation in state of the art cancer screening and prevention programs.

### Preliminary Goal

Prior to initiation of any education or intervention, the first aim of the partnership was to “identify barriers to cancer screening and research participation among medically underserved minority groups in East Harlem”. In order to identify such barriers, community interviews were undertaken as part of a preliminary needs assessment, of which the following presents an evaluation.

### Methods

#### The Community

East Harlem, located in northern Manhattan, has a population of 125,076, with 49% Hispanic (of any race); 46% African American; 6% White; and 2% Asian (U.S. Census, 2000). Recent immigrants include those from Mexico, the Dominican Republic, Central America and West Africa, in addition to the predominant Puerto Rican and African American population. East Harlem is characterized by high rates of poverty and unemployment, poor education levels and a high number of single-parent households. In 1995, 45% of the population received Medicaid benefits and almost 20% of the residents spoke little or no English ().

#### Recruitment of Participants

Men or women over the age of 18, English or Spanish-speaking, able and willing to give consent, who lived, worked and/or sought health care in East Harlem were deemed eligible to

participate and recruited in the community at health fairs, tenant associations meetings and senior centers, and at clinics at three partnership sites, Settlement Health Center, Boriken Neighborhood Health Center and Metropolitan Hospital Center. Recruitment and surveys were conducted between June-December 2000 by trained health educators and research interviewers, ethnically and linguistically similar to the residents of East Harlem.

### Measures

Sociodemographic variables assessed included age, marital and employment status, biological and other children living in the home, education, income, ethnicity, place of birth, time lived in the U.S., languages spoken, religion, and strength of faith. These were examined in three ways: firstly, a comparison among African Americans, English-language Hispanics and Spanish-language Hispanics; secondly, a sociodemographic comparison was made based on clinic versus community interview site to identify any differences related to those two populations; and thirdly, a comparison of the three clinic sites to examine population differences among these medical sites. Table 1 outlines the sub-scales included in the preliminary assessment.

Additional assessments addressed family health history and current medical care, including type of insurance, if any; access to health care; having a primary care provider; use of emergency departments; and smoking and alcohol use.

Medical mistrust was examined using a 12-item scale assessing suspicion of mainstream health care systems and health care professionals, as well as the treatment provided to individuals of the respondent's ethnic or racial group (Thompson, et al, under review).

The perceived benefits of and barriers to cancer screening were assessed with a 23-item likert-style questionnaire with items indicating the potential benefits, such as "Cancer screening

is now a very routine medical test”, and the potential barriers, e.g., “Getting screened for cancer has a high risk of leading to unnecessary surgery”. This scale was based on the work of Rakowski, et al, (1996, 1997) focusing on the pros and cons of mammography and pap tests.

Acculturation was measured separately for African American and Hispanic groups with a modified version of the acculturation measure developed by Snowden and Hines (1999) previously used in these populations.

The Powe Fatalism Inventory (Powe, 1995), was used to assess fear, pessimism, predetermination and the inevitability of death associated with cancer.

The Jones Temporal Orientation Scale () was used to measure an individual’s focus on the past, present or future.

Attitudes toward and knowledge of genetic testing were evaluated with a 33-item likert scale, including such items as “How much have you heard or read about genetic testing for breast cancer?” and “I would agree to genetic testing for cancer risk if my doctor recommended it”.

And, finally, cancer screening adherence and physician recommendations were assessed based on current ACS (2002) guidelines.

### Procedure

After obtaining informed consent, face-to-face interviews were conducted on-site or at a later date via telephone and lasted approximately one hour in duration. The interviews focused on current knowledge of various screening guidelines, individual screening habits, and potential barriers, such as fatalism, temporal orientation, medical mistrust, cancer worry and family history of cancer. A \$10 phone card or supermarket gift certificate was provided to all participants.

Table 1

**SURVEY BATTERY SUB-SCALES**

Social Demographics  
Family Health History  
Medical Care  
    Insurance  
    Primary Care Provider  
    Use of Emergency Departments  
    Access to Health Care  
Smoking/Alcohol Use  
Screening  
    Knowledge, Practice, Attitudes and Beliefs related to cancers of the  
        Breast, Cervix (women), Prostate (men), CRC  
    MD recommendations  
    Mammogram anxiety  
Perceived Cancer Risk  
Worry about Cancer  
Medical Mistrust  
Genetic Testing  
    Knowledge, Attitudes, Beliefs  
Jones Temporal Orientation Scale  
Cancer Fatalism  
Acculturation for African Americans, Hispanics, Whites  
Additional Components  
    for those with first degree relatives with Breast Cancer:  
        Index of Events Scale (IES, brief) re Breast Cancer  
        BRCA Testing Pros and Cons  
        BRCA Temporal Orientation  
        Group-centered Decision Making  
    for those with first degree relatives with Colon Cancer:  
        Index of Events Scale (IES, brief) re Colon Cancer  
        Attitudes and Beliefs re Genetic Testing for Colon Cancer  
        CRC Temporal Orientation

## Results

### Response Rate

Of 383 people approached, 248 (65%) agreed to participate in the survey. Significantly more women than men were approached (75% vs. 25%) and agreed to participate (70% vs. 50%). Additionally, a higher portion of people approached in the clinics versus the community declined to participate (45% vs. 11%). No differences in those who agreed to participate versus those who refused were noted in terms of ethnicity or age.

Face-to-face interviews were conducted with 173 participants, 70% of the sample, with the balance of 75 (30%) being done via telephone. Results are reported herein only for the African American and Hispanic participants who made up 96% of those surveyed.

### Sociodemographic Profile

The sociodemographic characteristics of participants are shown in Table 2. The breakdown, based on self-identified ethnicity and the language of the interview as preferred by the participant, revealed significant differences in the Hispanic sub-groups that would otherwise not have been determined. Spanish-language Hispanics were not born in the U.S. (100% vs. 44% of English-language Hispanics and 16% of African Americans); were less educated (21% postsecondary versus 36% and 38%); had 3 or more children (58% vs. 34 and 46%); less likely to be employed (87% vs. 64 and 70%); had income less than \$10,000 (71% vs. 53 and 41%); and received health care significantly more at one particular clinic, Settlement Health (60% vs. 30 and 35%). Additionally, Hispanics in general were more likely to be Catholic while African Americans were Protestant (92% and 82% vs. 23%) and more Hispanics were married or had a partner (38% and 43% vs. 24%). English-language Hispanics were also interviewed in clinics rather than the community (89% vs. 61 and 57%) and were significantly younger than the other

Table 2

Sociodemographic Characteristics  
(n= 237)

	<u>African American</u> (n = 109)		<u>Hispanic</u> Eng. (n = 61)		<u>Hispanic</u> Sp. (n=67)		Significance
	n	%	n	%	n	%	
Gender							
Female	91	84	47	77	56	84	n.s.
Male	18	16	14	33	11	16	
Education							
High school or less	67	62	39	64	53	79	*
At least some college	42	38	22	36	14	21	
Children							
1-2	54	54	37	66	25	42	*
3 or more	46	46	19	34	34	58	
Employed							
Yes	33	30	22	36	9	13	**
No	76	70	39	64	58	87	
Income							
Over \$10,000	61	59	27	47	17	29	***
Under \$10,000	43	41	30	53	42	71	
Insurance							
Government	71	70	39	65	44	68	n.s.
Private	21	21	10	17	6	9	
None	10	10	11	18	15	23	
Marital Status							
Married/Partner	26	24	23	38	29	43	**
Not Married	83	76	38	62	38	57	
Religion							
Catholic	21	23	44	92	50	82	***
Protestant	69	77	4	8	11	18	
Faith							
Strong	90	83	43	72	36	56	***
Not Strong	19	17	17	28	28	44	



Born in U.S.							
Yes	88	84	34	56			
No	17	16	27	44	65	100	**
Interview Language							
English	105	96	61	100			
Spanish	4	4			67	100	**
Interview Location							
Clinic	62	57	54	89	41	61	
Community Center	47	43	7	11	26	39	**
Settlement Health	20	35	16	30	24	60	
Boriken	31	54	24	45	11	28	
Metropolitan	7	12	13	25	5	13	**
Age (18-92)	$\bar{X} =$ 51.26	S.D. = 18.9	$\bar{X} =$ 41.10	S.D. = 14.1	$\bar{X} =$ 50.99	S.D. = 18.0	F (2,234) =7.5, p<.001

\*  $p < .05$ .

\*\*  $p < .01$ .

\*\*\*  $p < .001$ .

two populations ( $\bar{x}$ =41.10, S.D. 14.1 vs.  $\bar{x}$ =50.99, S.D. 18.0 for Spanish-language Hispanics and  $\bar{x}$ =51.26, S.D. 18.9 for African Americans).

#### Community/Clinic Comparison

Sociodemographics based on a comparison of those interviewed in the community versus the clinic are presented in Table 3. Important differences are evident: the community sample was more African American than Hispanic (59% vs. 40%); over 40 years of age (89% vs. 47%); had more children (57% vs. 40%); more health insurance (93% vs. 80%); were less likely to be married or have a partner (22% vs. 62%); were Protestant (52% vs. 36%); had more access to regular health care (92% vs. 80%); and, if Hispanic, were more likely to be born outside the U.S. (91% vs. 80%). No significant differences were noted in terms of education, income, African American place of birth, or language of interview.

#### Clinic Sites Comparison

A third review of demographics between the three clinic sites, Settlement Health, Boriken and Metropolitan Hospital Center, revealed no differences among any sociodemographic variables, with the exception of more Spanish-language Hispanic participants at Settlement Health.

Table 3

Community/Clinic Comparison  
Sociodemographic Characteristics  
(n= 237)

	Community		Clinic		Significance
	n	%	n	%	
<b>Gender</b>					
Female	66	78	135	83	
Male	19	22	28	17	n.s.
<b>Education</b>					
High school or less	59	69	103	63	
At least some college	29	31	60	37	n.s.
<b>Children</b>					
1-2	33	43	89	60	
3 or more	43	57	59	40	*
<b>Employed</b>					
Yes	18	21	51	31	
No	67	79	112	69	n.s.
<b>Income</b>					
Over \$10,000	38	48	75	50	
Under \$10,000	41	52	75	50	n.s.
<b>Insurance</b>					
Yes	68	93	123	80	
No	5	7	31	20	**
<b>Marital Status</b>					
Married/Partner	19	22	101	62	
Not Married	66	78	62	38	**
<b>Religion</b>					
Catholic	37	48	81	64	
Protestant	40	52	46	36	***
<b>AA Born in U.S.</b>					
Yes	35	80	53	87	
No	9	20	8	8	n.s.
<b>Hispanic Born in U.S.</b>					
Yes	3	9	31	33	
No	29	91	63	67	**
<b>Interview Language</b>					
English	56	66	120	74	
Spanish	29	34	43	26	n.s.
<b>Health Care Access</b>					
Yes	72	92	128	80	
No	6	8	31	20	*

<b>Ethnicity</b>					
<b>African American</b>	47	59	62	40	
<b>Hispanic</b>	33	41	95	60	**
<b>Age</b>					
<b>Under 40</b>	9	11	86	53	
<b>Over 40</b>	69	89	75	47	****

\*  $p < .02$

\*\*  $p < .01$

\*\*\*  $p < .05$

\*\*\*\*  $p < .001$

## Discussion

These findings present an initial report of the preliminary needs assessment of a community-based initiative, the East Harlem Partnership for Cancer Awareness, designed to increase the rates of cancer screening among minority, elderly and other underserved populations in an urban, inner-city neighborhood.

The success of this endeavor in recruiting hundreds of minority research participants is a testament to the value of a cooperative venture involving an academic medical center and local organizations having credibility within the target community. An existing basis of trust was enhanced through culturally congruent staff involved in recruitment and interview activities, as well as outreach efforts conducted in housing projects where community residents live, senior citizen centers where people socialize, and clinics, a source of both medical care and information.

Sociodemographics confirmed these East Harlem residents, both African American and Hispanic, as having lower socio-economic status, with a sizable portion not working, having income under \$10,000 and government-funded health insurance. Differences between minority groups and within minority sub-groups emerged, with African Americans more likely to be unmarried and having an income over \$10,000. Significant differences between Spanish-speaking Hispanics and both African Americans and English-speaking Hispanics point out the importance of acculturation in attempting to impact the health behaviors of medically underserved minority populations.

In spite of the heterogeneity of the Hispanic population in the United States, Hispanics are frequently perceived as a homogeneous group. Within this one community of New York City, significant variance was found among those self-identifying as Hispanic. Such differences

in place of birth, income, education and employment may impact the knowledge, attitudes, beliefs and behaviors of both groups relative to cancer screening. With low acculturation being related to a fatalistic attitude toward cancer and difficulty communicating with health care professionals, recognition of such differences is critical in the design of interventions to address low rates of cancer screening among Hispanics compared to Whites and African Americans, particularly in terms of meeting the Healthy People 2010 goals for colorectal cancer screening. Interventions targeting English-speaking Hispanics may appropriately reflect the dual acculturation and higher SES of this population, while interventions targeting less acculturated Spanish-speaking Hispanics may need to be more familial or communal and geared toward a lower literacy, lower SES group.

With a partnership objective of developing educational strategies to decrease sociodemographic, institutional and acculturative barriers to cancer screening, recognition of socio-cultural differences between minority groups and within minority sub-groups will facilitate cooperative efforts to develop promotional messages and strategies designed to increase cancer screening tailored to the African American and Hispanic communities. One identified characteristic of both ethnicities, strong faith, may provide another avenue of education through churches and faith-based groups.

Another major finding of the preliminary study was the difficulty of recruiting men. In response, a study is presently underway to explore the recruitment of men in the Emergency Department for research participation, while linking them with regular avenues of health care designed to increase access to and utilization of health care preventive services. Another approach would be to train women to be agents of change within their families/social networks,

encouraging expansion of their own commitment to regular cancer screening to husbands, partners, brothers and other family members.

Strength of the research includes its community-based cooperative basis, comprehensive self-report measures, the largely face-to-face interview format with interviewers culturally matched to the population, and sampling at various community sites as well as health clinics. Limitations include the disparity in the recruitment of men and utilization of an interview sample of convenience, thereby precluding generalizability of the findings.

Overall, these findings support the need to develop culturally sensitive, site-specific interventions to increase cancer awareness and screening in East Harlem among men and various ethnic sub-groups.

Running Head: ACCULTURATION AND BSE FREQUENCY

The African American Acculturation Scale and its Relationship to Smoking and Breast Self-  
Examination Frequency

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Abstract

The concept of acculturation is one factor that has been used to understand differences in health behaviors between and within a variety of racial and ethnic immigrant groups. Few studies, however, have examined the potential impact of acculturation on health behaviors among African-Americans. The present study had two goals: 1) to reconfirm relations between acculturation and cigarette smoking; 2) to investigate the impact of acculturation on another type of health behavior, cancer screening and specifically breast self-examination (BSE). African-American women (N=66) attending an inner-city cancer- screening clinic completed study questionnaires. Results reconfirmed psychometric properties of the AAAS; replicated the negative association between acculturation and smoking status; and found relations between African-American media preferences and women's adherence to BSE frequency guidelines. Findings from this study raise the possibility that specific aspects of acculturation may better explain specific health behaviors.

Further Psychometric Validation of the African American Acculturation Scale and its  
Relationship to Breast Self-Examination Frequency

The study of race as a factor in health and illness has a long-standing history in biomedical research. However, endeavors to explain differences in health and disease status on the basis of race as a biological indicator are no longer tenable as the scientific and medical community recognizes race to be a classification system constructed by society, not biology (Freeman, 1997). By conceptualizing race as a marker for other differences between groups (e.g., social circumstance, socioeconomic status (SES), cultural values and beliefs), we can obtain more meaningful information with implications for intervention and change. For example, some studies have found that after controlling for socioeconomic status, differences in health behaviors initially accounted for by race either diminish substantially or disappear completely (Breen & Keesler, 1994; Calle, Flanders, Thun, & Martin, 1993; Hiatt et al., 1996). Similar to SES, but less studied in the literature is acculturation, which may also better explain differences between groups as well as differences within groups.

Acculturation refers to the process in which an individual adopts or adheres to attitudes, beliefs, practices, or behaviors congruent with that of the dominant culture. Acculturation is a complex process involving multiple components (Berry, 1980), and the meaning of acculturation can vary depending on how it is measured. Efforts to operationalize acculturation have recognized the multi-dimensionality of the construct by incorporating factors such as traditional rituals and practices, food and activity preferences, ethnic composition of one's interpersonal relationships, values, and perceived self-identity. In addition, immigration status variables (e.g., place of birth, generational status in U.S., length of residency) have been used to calculate a

person's level of acculturation. Earlier stages of acculturation measurement research produced scales applicable to more inclusive ethnic and cultural groupings such as Asian Americans (Suinn, Richard-Figueroa, Lew, & Vigil, 1987), Hispanic Americans (Marin, Sabogal, Marin, & Otero-Sabogal, 1980), and Native Americans (Hoffman, Dana, & Bolton, 1985). More recently, acculturation scales have been designed to appreciate cultural distinctions within ethnic groups: Puerto Ricans (Tropp, Erkut, Coll, Alarcon, & Garcia, 1999), Greek-Americans (Harris & Verven, 1996), Taiwanese aboriginals (Cheng & Hsu, 1995), and Southeast Asians (Anderson et al., 1993).

Although acculturation is a concept that has attracted a great deal of attention in psychological research, it has received little research attention in the African-American community. According to Landrine and Klonoff (1994), the identification of African-Americans as a racial group, first, and an ethnic or cultural group, second, may explain the relative delay in exploring acculturation in this population. To date, only two scales have been developed to measure acculturation within the African-American population (Landrine & Klonoff, 1994; Snowden & Hines, 1999). Landrine and Klonoff's (1994) scale assesses several dimensions of African-American culture theoretically derived to reflect the degree of connection an individual has to African-American culture as opposed to the dominant culture (i.e., White American culture). Importantly, scores on the separate subscales of the AAAS have not been found to be associated with income, social class, or level of education. This lack of confounding with other demographic variables suggests its potential to explore cultural constructs as they relate to other behaviors, performance, or functioning.

Acculturation has been examined increasingly as one of the factors accounting for variation in health behaviors among different cultural groups. For example, acculturation has been found to be positively associated with ever having had a pap test among young Asian-American women (Tang, Solomon, Yeh, Worden, 1999), ever having had a mammography, first time and recent mammography or clinical breast exam among Hispanics (O'Malley, Kamer, Johnson, & Mandelblatt, 1999), illicit drug use among Mexican men and women (Vega, Alderete, Kolody, & Aguilar-Gaxiola, 1998) and greater alcohol consumption among Mexican American women (Alaniz, Treno, & Saltz, 1999). Among Korean Americans, high acculturation is related to higher body weight and light physical activity (Lee, Sobal, & Frongillo, 2000). In addition, smoking behavior has been linked to acculturation. Chen, Unger, Cruz, and Johnson (1999) found greater smoking behavior and earlier onset of smoking among more highly acculturated Asian-American youth, a relationship also documented in other Asian and Latino populations of varied ages (Ebin, et. al, 2001; Lee, Sobal & Frongillo, 2000; and Unger et. al, 2000).

Few studies have examined the relationship of acculturation and health behaviors among African-Americans (Landrine & Klonoff, 1994; Klonoff & Landrine, 1999; Brook, Whiteman, Balka, Win, & Gursen, 1997). Landrine and Klonoff (1996) used the AAAS to examine the role of acculturation in cigarette smoking status, and a significant relationship was found.

Specifically, African Americans who scored as less acculturated were more likely to be smokers.

Klonoff and Landrine (1999) replicated this finding in a community sample. Here, they found a significant association between the total acculturation score and smoking status, with less acculturated African-Americans being more likely to smoke. To our knowledge, there have

been no studies using the AAAS to assess relations between acculturation and any health behavior other than smoking. The present study examined the role of acculturation in breast self-examination (BSE) frequency.

Although BSE has not been proven unequivocally to be effective in detecting breast cancer or reducing mortality related to the disease, it has been recommended consistently by national clinical societies (e.g. American Cancer Society, American Society of Clinical Oncology) as an important aspect of breast cancer surveillance, which has been shown to detect significant number of breast cancers (Porter, 1999). Among economically disadvantaged groups, cost can be a barrier to participating in clinical breast cancer screening (Rimer, 1992). Given that BSE is a cost-free screening procedure that is under a woman's personal control, examining BSE behavior among African American women is particularly relevant. Existing studies on BSE among African American women has yielded inconsistent results, with some indicating African American women tend to under-perform BSE (Underwood, 1999) and others indicating African American women tend to over perform BSE (Epstein et al., 1997). While BSE under-performance is well recognized to decrease the efficacy of this screening modality (Coleman, 1991), BSE over-performance is also thought to decrease the utility in women's ability to detect gradual changes in the breast (Haagensen, 1952).

As an example of a self-initiated health promoting behavior, it is important to understand factors that may encourage or deter BSE among African American women. The aims of the present study were to re-examine the relationship of acculturation and smoking status in an urban, inner city sample of African American women, and to examine the role of acculturation in another health behavior (BSE frequency). The AAAS has been recently revised to drop 26 items

(Klonoff & Landrine, 2000), based on feedback from other investigators who reported that participants found many items objectionable. The present study, initiated before the scale revision, was completed without negative feedback by participants (see below).

### Method

Data were gathered as part of a larger ongoing investigation of stress associated with having a family history of breast cancer. Results reported here are from women recruited from an inner city cancer screening clinic who self-identified as African American.

Setting. The Breast Examination Center of Harlem (BECH) provides advanced, comprehensive diagnostic screening services to members of the Harlem community. All services are provided at no out of pocket expense to the client. Ninety-seven percent of BECH's clientele is Black or Latina. At the time data was collected for this study, BECH's staff was 95% Black or Hispanic. Particularly relevant to this study, nurse practitioners at the BECH give clients instruction on how to properly perform BSE and frequency guidelines (i.e., once a month) are emphasized. Videotaped instructions on how to perform BSE also play repeatedly in the waiting area.

### Procedure.

Participants were recruited from the BECH's waiting room on scheduled clinic days by an African American female researcher (JG). After agreeing to participate, all were given an appointment to meet with the researcher three to four weeks afterwards to complete study questionnaires. This schedule was to ensure that subjects would receive results of cancer screening prior to the interviews. None of the women received abnormal results. One subject who required a follow-up clinic visit due to unclear or suspicious results was excluded from the

study. All women completed standardized measures (described in detail below) that assessed African American acculturation and breast self-examination behavior in addition to the measures used in the larger study. As noted by the developers of the AAAS (Landrine & Klonoff, 1996) highly acculturated subjects may find the scale offensive, therefore, care was taken to explain the purpose of the measure to all participants. In our sample, only one woman refused to complete the measure, saying she did not see its relevance to her experience. Participants received \$20 plus the cost of round trip public transportation for the visit.

#### Participants.

To be eligible participants had to be 25 or older, able to read/write English, and able to provide meaningful informed consent. The study excluded women who had a personal history of neoplasm or abnormal pathologic reports or were pregnant. The data of two women were deleted: the woman who did not complete the AAAS, and that of one woman with extreme missing data on the AAAS. As a result, 66 women completed all the measures.

#### Measures.

Demographic and Medical questionnaire. A standard questionnaire (Valdimarsdottir et al., 1995) was used to obtain information on age, education, and other demographic variables.

Age ranged between 26 -72 years, ( $M = 45.00$ ,  $SD = 10.70$ ). Eighty-five percent completed at least some high school. Income was trichotomized into  $< \$10,000$  ( $n=12$ );  $\$10,000$ - $\$39,000$  ( $n=40$ ); and  $> \$39,000$  ( $n=14$ ). Sixty- three percent were currently employed, and 30% were currently married. Forty-five percent were smokers as indicated by their responses to question taken from the National Health Interview Survey (Benson & Marano, 1995): "During your lifetime, have you smoked at least 100 cigarettes (5 packs)?" Smoking was unrelated to



demographics in this data set. Forty-one percent had at least one first-degree relative (FDR) with breast cancer. It should also be noted that preliminary statistical analyses revealed no associations between FDR status and any other measure in the study.

### Behavioral Measures

Assessment of breast self-examination. Two questions, based on published results and modified by the research team, assessed breast self-examination frequency. First, participants were asked: "How often do you perform breast self-examination? (1) *More than once a month*; (2) *Once a month*; (12 times a year); (3) *Every other month* (6 times a year); (4) *Four or five times a year*; (5) *Two or three times a year*; (6) *Once a year*; (7) *Never*. Under-performance was operationally defined as those women who performed BSE less than once a month. Second, over-performance in the period following their clinical examination was evaluated with the question: "In the past three weeks, how many times did you perform breast self-examination? (a) *Never* (b) *Once* (c) *2-3 times* (d) *4-5 times* (e) *Six or more times*." Over-performance was operationally defined as performing BSE more than once during the prior three weeks. As would be expected, results on the two measures of BSE frequency were significantly related (chi-square  $F=55.36$ ,  $p < .001$ ).

### Acculturation Measure.

African-American Acculturation Scale (Landrine & Klonoff, 1994). This 74-item measure assesses eight dimensions of African-American culture, which are: 1) Traditional African American Religious Beliefs and Practices (6 Items); 2) Traditional African American Family Structure and Practices (12 Items); 3) Traditional African American Socialization (11 Items); 4) Preparation and Consumption of Traditional Foods (10 Items); 5) Preference for

African American Things (11 Items); 6) Interracial Attitudes (7 Items); 7) Superstitions (5 Items); and, 8) Traditional African American Health Beliefs and Practices (12 Items). Answers are reported in a Likert-style format, which range from (1) Strongly Disagree to (7) Strongly Agree. A subject's score on a sub-scale is computed as the sum of the answers on that sub-scale, and a Total Summary Score is also computed. A higher score is thought to represent more traditionally African American views. Published reports by the scale's developers have demonstrated its psychometric properties (Landrine & Klonoff, 1994; Landrine & Klonoff, 1996).

With regard to missing data, only one of the remaining participants omitted more than 6 items from the entire measure, and no participant missed more than 3 items from any one sub-scale suggesting that missing items were randomly distributed. Following published procedures of the AAAS' s developers, we used mean substitution to replace missing items within sub-scales (Landrine & Klonoff, 1996).

## Results

Phase 1 -In this phase of the study, we first examined the psychometric properties and concurrent validity of the AAAS using data from a sample of 35 women who completed the full questionnaire. More critically, we examined relations between AAAS scores and a health behavior (e.g., smoking) previously reported to be associated with those scores (Klonoff & Landrine, 1996). Having confirmed previous findings with the AAAS, we then examined the relations between scores on that measure and BSE. Consistent with previously published results (Landrine & Klonoff, 1994), data from this sample demonstrated a wide range of scores (e.g., a range of over 250 points on the total AAAS score and a range of more than 200 points on the

total AAAS score found in previously published results). Also consistent with published findings (Landrine & Klonoff, 1994), in this data set the AAAS was not significantly related to demographic variables.

We next examined concurrent validity of the AAAS by following the previously published approach of the scale's developers. They argued that persons of an ethnic group who live in an ethnic-minority neighborhood are likely to be the more traditional members of their culture (because of constant exposure to the culture), whereas those who live in predominately White or integrated neighborhoods are likely to be more acculturated (Landrine & Klonoff, 1994). Thus, we examined the scores of the answers to the question "I currently live in a Black neighborhood" - (question 68 on the Traditional Socialization sub-scale) and divided the subjects into two extreme groups: 1) The "Other residence" group consisted of the women in this sample who circled "This is absolutely not true of me" ( $n=5$ ); and 2) the "Black neighborhood residence" group who circled "This is absolutely true of me" ( $n=20$ ). MANOVA analyses revealed that women who circled "This is absolutely true of me" scored significantly higher (i.e., more traditionally African American) than those who answered, "This is absolutely not true of me" (i.e., more acculturated) across the eight AAAS sub-scales and the Total Summary Score ( $F=2.86$ ,  $P < .034$ ). Next we examined the relations between acculturation and smoking. MANOVA analyses revealed that smokers ( $n=16$ ) scored higher than non-smokers ( $n=19$ ) across the eight sub-scales and on the Total Summary score ( $F = 2.50$ ,  $p < .036$ ). Upon closer examination of the data (Table 1), we found significant differences between the smokers and non-smokers on the Family Practices ( $F = 5.14$ ,  $P < .030$ ) and Interracial Attitudes ( $F = 4.71$ ,  $P < .037$ ) sub-scales, and on the Total Summary Score ( $F = 5.79$ ,  $P < .021$ ).

Finally, we examined the AAAS scores in relation to BSE frequency. Table 2 shows the eight sub-scales and their relationship to BSE frequency. ANOVA results revealed that the mean for BSE "Under-performers" ( $n = 17$ ) differed from "Others" ( $n = 18$ ) on the Preference for African American Things sub-scale, the Socialization summary score and on the Total Summary Score. Women who under-performed BSE (i.e., less than once a month), scored lower on these sub-scales (i.e., more acculturated). The difference on the Preference sub-scale remained significant after Bonferroni correction to reduce possible Type I error associated with assessment of multiple outcomes (i.e.,  $p < .05$  divided by 9 = .005). Consistent with these results, analysis of BSE over performance indicated that "Over-Performers" ( $n = 21$ ) also differed from "Others" ( $n = 14$ ) on the Preference for African American Things and Socialization sub-scales, as well as on the Total Summary Score. We found that women who over-performed BSE scored significantly higher on the Preference sub-scale of the AAAS (i.e., higher scores indicate greater preference) even after Bonferroni correction.

Phase 2 – In this phase of the study, an additional 31 women completed only the Preference for African American Things sub-scale (12 items) in addition to the other study measures, to provide additional data on the relationship between this sub-scale and BSE frequency. The focus on that sub-scale served to reduce participant burden, while providing additional data on the one AAAS sub-scale that indicated a significant relation to BSE frequency in Phase 1. Confirming what was found in Phase 1, women who under performed BSE scored significantly lower on the Preference for African American Things sub-scale ( $F = 6.42$ ,  $p < .013$ ); the mean score for "Under-performers" ( $N = 31$ ; mean 45.48, S.D. 13.82) versus "Others" ( $N = 35$ ; mean 53.53, S.D. 11.98). For over-performance the pattern was again similar to that in Phase 1;

the mean Preference scores of "Over-Performers" (N=23; mean 56.23 S.D. 9.42) was significantly higher than for "Others" (N=43; mean 46.28, S.D. 14.01) ( $F = 9.29, p < .003$ ).

Given the findings relating Preference scores and BSE frequency, it was of interest to examine the individual items on that sub-scale as a first step in considering potential explanations for the relations (Table 3). For BSE under-performance, only questions 18 (*i.e., I read, or used to read, Essence magazine*) and 23, (*i.e., I read, or used to read, Jet magazine*) reached significance. The mean score of women who under-performed BSE was significantly lower on those questions ( $F=10.72$  and  $F=10.26$ , respectively;  $p < .002$  for both questions). For BSE over-performance, only question 16 (*i.e., I listen to Black radio stations*) reached significance. The mean score of women who over-performed BSE was significantly higher on question 16 ( $F=10.58; p < .001$ ).

### Discussion

The objectives of this study were to re-confirm the psychometric properties and validity of the original African American Acculturation Scale (AAAS) (Landrine & Klonoff, 1994) in an independent sample of urban, inner city African American women, to re-examine the relationship between acculturation and smoking status, and to investigate the role of acculturation in breast self-examination (BSE). Descriptive statistics of scores on the AAAS in our sample were similar to those found in reports by the scale's developers (Landrine & Klonoff, 1994). That is, we found similar ranges in variability for total acculturation and dimension scores, and also found that women who lived in a African American community scored higher on the AAAS (*i.e., less acculturated*) compared to women who lived in a integrated community. Also consistent with initial reports by the scale's developers, we did not find responses on the AAAS to be associated

with income, social class, or level of education. These results provide further corroboration for the validity of the AAAS as a measure of the acculturation construct. We also replicated the relationship between acculturation and smoking status reported in previous studies (Landrine & Klonoff, 1996; Klonoff & Landrine, 1999). Consistent with those studies, we found a negative association between acculturation and smoking, with less acculturated African American women more likely to be smokers. This is in contrast to research with Latino and Asian American populations. Future research should investigate the mechanisms which underlie this difference. It may be a reflection of the fact that acculturation for Latinos and Asian Americans has been based on integration into North American culture following immigration. For African Americans, deeper integration into "mainstream" culture does not necessarily imply the loss of tightly anchored, historical cultural traditions.

Interestingly, the acculturation dimension that predicted smoking status in the present study, as well as those conducted by the scale developers, was Family Structure and Practices. This dimension reflects the extent to which one's immediate and extended family adheres to practices, customs, and values (e.g., informal adoption) specific to African American culture (Landrine & Klonoff, 1994). It is unclear why smoking was linked to family practices in this sample. The literature has found parental smoking behavior and other family environmental factors to be significantly associated with children's current and future smoking behavior (Jackson, Henriksen, Dickinson, Levine, 1997; Jackson, Henriksen, Dickinson, Messer, Robertson, 1998; Bailey, Ennett, Ringwalt, 1993). Yet, research shows that African American parents are more likely to employ proactive anti-smoking socialization with their children than European American parents (Clark, Scarisbrick-Hauser, Gautam, & Wirk, 1999; Gittelsohn,

Roche, Alexander, & Tassler, 2001), and the literature shows that African American youth smoke less and start later than their European American peers (Bobo & Husten, 2000; Ellickson, McGuigan, & Klein, 2001; Harrell, Bangdiwala, Deng, Webb, & Bradley, 1998; Vega, Gil, & Zimmerman, 1993).

The final aim of this study was to explore the role of acculturation in BSE under-performance and over-performance. Breast self-exam is related to earlier pathological stage of cancer diagnosis and symptom presentation, smaller tumor size, and less axillary lymph node involvement (Foster & Costanza, 1984; Hugley & Brown, 1981; Philip, Harris, Flaherty, & Josline, 1986). In addition, Porter et al. (1999) found that 66% of tumors detected between mammography screening intervals were discovered via breast self-examination. Tumors detected during screening intervals were larger in size, more severe in disease stage, and more prevalent in younger women. Thus, BSE may be particularly beneficial as a method of detection for younger women whose disease progression is faster and more aggressive (Porter et al., 1999). Given the available evidence, BSE continues to be recommended strongly as a good health behavior and important breast cancer screening modality by the American Cancer Society (ACS, 1999) and the American Society of Clinical Oncology (Smith et al., 1999), respectively. With regard to rates of BSE performance, fifty-one percent of the women in this study reported performing BSE at least once a month. This rate is consistent with the rate (49.7%) reported in a random sample of low income, African American women ages 40 and over living in a Florida city (Mickey, Durski, Worden, & Danigelis, 1995) and also fell into the range (41 % to 67%) reported by other populations of women 50 and older in the U.S. (NCI Breast Cancer Screening Consortium, 1990).

While under-performing BSE has obvious implications for the utility of this screening modality, less appreciated are the potential drawbacks to over-performing BSE. It has long been recognized that over-performing BSE may decrease a woman's ability to detect gradual changes in the breast as well as induce cancer anxiety (Haagensen, 1952). Excessive BSE performance may also increase the likelihood of false positive findings, which, in turn, may result in increased anxiety (Lennan, Kash, & Stefanek, 1994; Haefner, Becker, & Janz, 1989). Women may also use their over-reliance on BSE as a screening modality as a reason for opting out of or not adhering to other screening modalities such as mammography (Epstein & Lerman, 1997). Both under- and over-performance of BSE may then lead to diminished utility of this screening modality.

Results of the present study revealed significant associations between acculturation and BSE frequency. BSE under-performers were more acculturated, and BSE over-performers were less acculturated. In addition to identifying a relationship between global acculturation and BSE frequency, we found that Preference for African American Things was also significantly correlated. This subscale reflects the extent to which an individual has a preference for African American newspapers, periodicals, music, activities, arts, and people (Landrine & Klonoff, 1994). Close inspection of this dimension with item analyses revealed that items related to Black print media were significantly associated with BSE under-performance, where under-performers were less likely to read these magazines.

BSE over-performance was significantly associated with one item: I) "I listen to Black radio stations", where over-performers were more likely to listen to these stations. Taken together, these findings highlight the importance of mass media in publicizing breast cancer as a major health concern. Turnbull (1978) found that a significant proportion of women increased



their BSE performance from no performance/under performance to once a month or more as a result of the mass media surrounding Betty Ford's mastectomy. Additionally, women cited television/radio and periodicals/books as their number one and two sources of information, respectively (Turnbull, 1978). Among Latina women, Richardson et al. (1987) also found those reported reading or hearing about (via television) the importance of performing BSE were more likely to perform BSE more frequently. Based on these studies, it would appear that mass media is influential in breast cancer screening among ethnic minority women and women in general. That an association was suggested between exposure to African American mass media and BSE frequency among African American women in the present study is consistent with past research.

We do not know whether women who did not read Black magazines simply read other periodicals, or whether they were not exposed to print media at all. This knowledge would be important in determining an appropriate means by which to effectively reach this population through the press. This is particularly important given that African American women have the highest rate of breast cancer mortality among women in the U.S (ACS, 1999). This differential impact may well be reflected and underscored in African American media sources as compared to the general mass media. Future research should compare breast cancer coverage between difference media sources examining both the frequency of breast cancer articles appearing in issues as well as accuracy and clarity of information presented in articles.

These findings suggest the importance of identifying specific acculturation mechanisms that may influence the behavior of interest. Different health behaviors are likely to be associated with different acculturation dimensions. For example, Tang et al., (1999) found that among Asian American women, modesty was related to BSE, but not other aspects of culture. And, the

present study found the Family Structure and Practice dimension to be significantly associated with smoking status, as did Landrine and Klonoff, 1996, and Klonoff and Landrine, 1998. Increasing the specificity with regard to the role of acculturation in health behaviors may thus assist us in targeting specific barriers for intervention. Results from the present study have several clinical implications. Because the medical community has been focused predominantly on promoting breast cancer screening behavior, the problem of over-utilization or over-performance of screening has perhaps received less attention.

Limitations to this study should be noted. Because the sample size was relatively small and women were recruited specifically from a low-income, inner city breast cancer-screening center, our results cannot be generalized to all African American women. Moreover, it is likely that the prevalence of BSE under-performance and/or over-performance may be higher among women who do not receive BSE education and training as those in our sample did. We deliberately selected women who were instructed by African American health care providers in proper BSE technique in order to hold BSE training, knowledge of BSE guidelines, and ethnic background of health care providers constant.

The study of African American acculturation is an emerging area of research. Initial results on the relationship between acculturation and smoking status and BSE frequency suggest that this concept has some utility in understanding some of the variability among African-American women in health behaviors. Future studies should examine acculturation in relation to breast cancer screening modalities other than BSE. Given that African American women have the highest mortality rate for breast cancer and routine mammography has been shown to be effective in reducing breast cancer mortality by approximately 40% (Frisell, Lidbrink, Hellstrom,

& Rutqvist, 1997), it would be important to investigate possible cultural variables are one of the factors associated with mammography utilization. In terms of assessment with the AAAS, Klonoff and Landrine (2000) recommend that researchers use the shortened revised version. Although our sample did not have negative feedback regarding the scale, a shorter version at the very least reduces participant burden. It will be useful to examine whether the items remaining in the revised version continue to predict health variables such as BSE.

Future research should also explore the role of the mass media in publicizing breast cancer screening information among African American women as well as other ethnic groups. While breast cancer impacts differently women of various ethnic backgrounds, how this information is presented and explained in the media may well influence women's screening behaviors. As a construct, acculturation may provide useful information for enhancing our understanding of differences between and within groups that racial distinctions cannot, although other variables (e.g. socioeconomic status) must also be investigated. Clearly, the value of the concept of acculturation in clinical research depends on how it is operationalized and utilized in understanding and predicting other health behaviors. For African Americans, acculturation may be best defined as participation in and facility negotiating the dominant culture, rather than preferences for African American things. By identifying specific acculturation components that facilitate or deter health behaviors, we may be better able to implement interventions to improve health status among different ethnic and cultural communities.

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Table 1

AAAS scores for women with or without history of smoking

AAAS	Smokers (n=16)	Non Smokers (n=19)	F	p
Preferences	56.03	45.92	3.58	.067
Family Practices	61.02	51.56	5.14	.030
Health Beliefs	54.43	50.68	0.60	.445
Socialization	53.75	49.56	0.73	.397
Foods	44.95	37.34	2.90	.098
Religion	32.69	36.87	2.11	.155
Interracial Attitudes	34.33	26.54	4.71	.037
Superstitions	25.31	21.4	2.80	.104
Summary Score	366.71	315.62	5.79	.021

Table 2

Women who Under Perform BSE Scored Lower than Women who Over Perform BSE

AAAS Scale	Under Performance Assessment				Over Performance Assessment			
	Past year				Past 3 weeks			
	Under Performers (n=17)	Others (n=18)			Under Performers (n=17)	Others (n=18)		
	Mean (S.D.)	Mean (S.D.)	F	Sig.	Mean (S.D.)	Mean (S.D.)	F	Sig.
Preferences	<b>42.13 (16.11)</b>	<b>58.48 (12.32)</b>	<b>11.46</b>	<b>.001</b>	<b>59.88 (8.05)</b>	<b>44.31 (17.60)</b>	<b>9.55</b>	<b>.004</b>
Family Practices	54.55 (14.45)	57.05 (12.11)	0.31	.581	58.71(12.18)	53.92(13.72)	1.12	.298
Health Beliefs	49.66 (14.14)	54.97 (14.18)	1.23	.275	55.03(14.38)	50.63(14.17)	0.8	.376
Socialization	45.79 (15.27)	56.84 (11.35)	5.94	.020	58.54(9.12)	46.54(15.22)	7.36	.010
Foods	38.01(12.47)	43.47(14.28)	1.45	.237	45.28(13.66)	37.84(12.90)	2.66	.112
Religion	32.12 (10.41)	36.94(5.85)	2.88	.098	38.00(4.15)	32.34(10.07)	3.94	.055
Interracial Attitudes	28.53(10.25)	31.58(11.79)	0.65	.426	31.45(12.24)	29.20(10.54)	0.34	.566
Superstitions	21.56(7.58)	24.72(6.37)	1.78	.191	25.71(6.50)	21.50(7.06)	3.16	.084
Summary Score	312.39(70.38)	364.09(53.79)	6.00	.010	372.96(41.84)	316.32(71.45)	7.12	.011

\*Bolded numbers indicate Bonferoni corrected significance was reached ( $p < .05$  divided by 9 = .005).

Note: Re-analyses excluding women whose responses revealed long-term under performance and short-term over performance (n=4) yielded an identical pattern of results.

e 3

idual Items from the Preference for African American Things Sub-scale

S Scale: Answers range from 1-7  
ngly disagree-agree)

Under Performance Assessment  
Past year

Over Performance Assessment  
Past 3 weeks

	Under Performers (n=17)		Others (n=18)		F	Sig.	Under Performers (n=17)		Others (n=18)		F
	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)			Mean (S.D.)	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)	
I know how to play bid whist	2.53 (1.99)	3.14 (2.45)	1.21	.274			3.00 (2.41)	2.77(2.18)	.14		
Most of my friends are Black	5.22 (1.82)	5.62(1.73)	0.85	.361			6.13 (1.21)	5.06 (1.91)	5.76		
I feel more comfortable around Blacks than around Whites	4.25 (2.12)	4.40 (2.11)	0.07	.787			4.47 (2.12)	4.25 (2.11)	0.16		
I listen to Black radio stations	4.45 (2.17)	5.22 (1.71)	2.63	.110			<b>5.86 (1.51)</b>	<b>4.32 (1.98)</b>	<b>10.58</b>		
I try to watch all the Black shows on T.V.	3.11 (2.28)	4.00 (2.30)	2.42	.124			4.60 (2.23)	3.03 (2.20)	7.55		
I read (or used to read) Essence magazine	<b>4.38 (2.33)</b>	<b>5.97 (1.56)</b>	<b>10.72</b>	<b>0.001*</b>			6.13 (1.32)	4.74 (2.28)	7.12		
Most of the music I listen to is by Black artists	4.09 (2.19)	5.14 (1.68)	4.78	.032			5.26 (1.54)	4.32 (2.14)	3.41		
I like Black music more than white music	4.96 (2.18)	5.08 (1.90)	0.06	.810			5.34 (1.69)	4.85 (2.17)	0.88		
The person I admire the most is Black	5.22 (1.97)	5.89 (1.68)	2.17	.145			6.40 (1.06)	5.13 (2.02)	7.79		
When I pass a Black person (a stranger) on the street, I always say hello or nod at them	3.28 (2.20)	3.70 (5.33)	0.64	.426			3.53 (2.04)	3.49 (2.19)	0.00		
I read (or used to read) Jet magazine.	<b>3.93 (2.01)</b>	<b>5.33 (1.52)</b>	<b>10.26</b>	<b>0.002*</b>			5.46 (1.52)	4.25 (1.95)	6.68		

Ided number indicated Bonferroni corrected significance was reached ( $p < .05$  divided by 11 =  $p < .004$ )

## Bovbjerg, Dana

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**From:** Bovbjerg, Dana  
**Sent:** Thursday, March 28, 2002 1:16 PM  
**To:** Moshier, Erin  
**Cc:** Montgomery, Guy; Godbold, Jim; Todd, Andrew  
**Subject:** RE: grant submission

Hi Erin,

We want to have a biosketch for every investigator. Whether a formal requirement or not, it strengthens the grant for review. I think it is also appropriate that you and Jim be listed as key personnel, but if there is concern about that for some reason, please let me know and we can discuss it.

As I mentioned, we will also be asking you (and each of the collaborative team) for a letter of support (which we will draft), to highlight their roles and indicate relevant background. Although not a formal requirement, this too strengthens the grant.

These approaches are based on my experience in successfully competing for grants over the past 20 years, as well as my experience on several NIH study sections, most recently last year. I would be happy to discuss the strategy with you, and/or your colleagues if you like.

Dana

\*\*\*\*\*

Dr. Dana Bovbjerg  
Head, Biobehavioral Medicine Program  
Ruttenberg Cancer Center, E16-75  
Mount Sinai School of Medicine  
One Gustave L. Levy Place, Box 1130  
New York, NY 10029-6574  
Phone: 212/659-5562  
Fax: 212/849-2566

-----Original Message-----

**From:** Moshier, Erin  
**Sent:** Thursday, March 28, 2002 10:33 AM  
**To:** Bovbjerg, Dana  
**Cc:** Godbold, Jim  
**Subject:**

Hi Dana,

I just spoke with my former boss, Dr. Andrew Todd, about submitting a bio-sketch for your grant and he said that it's not necessary as I am not "key personnel". We need to discuss this with Jim next week to get his input and see how he handled this on other grants.

Thanks,  
Erin

E-20 JS

## FAMILY HISTORIES OF BREAST CANCER, HEALTH LOCUS OF CONTROL, AND COPING

Youngmee Kim, Ph.D., Heiddis B. Valdimarsdottir, Ph.D., and Dana H. Bovbjerg, Ph.D., Mount Sinai School of Medicine

Having first-degree relatives with breast cancer as a major life event can influence how women in the family cope in general. First, it was examined if these women (FH+) utilize emotion-focused or problem-focused coping strategies in differing degrees from women without such family history (FH-). Second, beliefs in health locus of control as potential mediators in the relation between family histories of breast cancer (FHBC) and coping strategies were tested. One hundred sixteen healthy women (47 FH+ and 69 FH-) participated in the study. They completed the Ways of Coping Questionnaire (measuring emotion-focused and problem-focused coping strategies) and the Multidimensional Health Locus of Control Scale (MHLOC: measuring internal, external, and impersonal health locus of control). Results showed group differences in utilizing coping strategies: FH+ women utilized both emotion-focused ( $\beta = -.27, p = .004$ ) and problem-focused coping strategies ( $\beta = -.20, p = .035$ ) less frequently than FH- women. Associations between FHBC and MHLOC dimensions were also found (for each MHLOC dimension,  $\beta$ s =  $-.27, -.18, -.20, p$ s =  $.027, .079, .045$ , respectively), but only external LOC was significantly associated with emotion-focused coping. When both FHBC and external LOC were included in the analysis, the relation between FHBC and emotion-focused coping became weaker ( $\beta = -.22, p = .024$ ), indicating partial mediating effect of external LOC. The MHLOC measures were not significantly associated with problem-focused coping. The results suggest that the FH+ women believe less that others (e.g., health professionals) can control their own health, which in turn is associated with lower degree of utilization of emotion-focused coping strategies.

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## What Is Satisfying About Satisfying Events? Testing 10 Candidate Psychological Needs

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University of Missouri—Columbia

Andrew J. Elliot and Youngmee Kim  
University of Rochester

Tim Kasser  
Knox College

Three studies compared 10 candidate psychological needs in an attempt to determine which are truly most fundamental for humans. Participants described "most satisfying events" within their lives and then rated the salience of each of the 10 candidate needs within these events. Supporting self-determination theory postulates (Ryan & Deci, 2000)—autonomy, competence, and relatedness, were consistently among the top 4 needs, in terms of both their salience and their association with event-related affect. Self-esteem was also important, whereas self-actualization or meaning, physical thriving, popularity or influence, and money–luxury were less important. This basic pattern emerged within three different time frames and within both U.S. and South Korean samples and also within a final study that asked, "What's unsatisfying about unsatisfying events?" Implications for hierarchical theories of needs are discussed.

Psychologists have long speculated about the fundamental psychological needs of humans, beginning with McDougall (1908) and Freud (1920) and continuing on through Murray (1938) and Maslow (1954) to the present day (Baumeister & Leary, 1995; Reis, Sheldon, Gable, Roscoe, & Ryan, 2000). Need concepts are attractive because they can potentially provide genotypic explanations for the wide variety of phenotypic behaviors that individuals express (Baumeister & Leary, 1995). By assuming that humans strive for certain fundamental qualities of experience, one is enabled to see unity (or equifinality) within broad diversities of behavior. Need concepts are also attractive because they readily suggest psychosocial interventions. That is, once identified, psychological needs can be targeted to enhance personal thriving, in the same way that the organic needs of plants, once identified, can be targeted to maximize thriving in the plant (Ryan & Deci, 2000). Finally, need constructs may offer a way to unify the field of motivational psychology, in the same way that the Big Five model has served to unify trait psychology. To settle on a basic set of human needs would serve to anchor a wide variety of motivational and functional analyses.

Unfortunately, the utility of the psychological need construct has been limited thus far. In part, this is due to the large number of

potential needs that have been posited and the corresponding lack of consensus regarding which are most central or primary. In this sense the psychological need construct stands in the same stead as the early instinct concept, which collapsed because of a similar multiplicity (Weiner, 1992). In addition, there has been little consensus on the exact definition of needs. Are they ineluctable motive forces, pushing out from the person, or are they required experiential inputs, coming into the person (McClelland, 1985)? Furthermore, there is little consensus on what criteria to use to identify needs. Do needs refer to almost any type of desire or craving, or perhaps only to certain special, health-inducing motives (Ryan, 1995)? Finally, it is unclear where psychological needs come from. Are they acquired individual differences, perhaps learned early in life and perhaps varying across cultures, or are they inherent and universal in their scope, perhaps enplaced into human nature by evolution (Tooby & Cosmides, 1992)?

The purpose of this article is to comparatively examine 10 different feelings, each of which has been proposed as a need by prominent psychological theories, in order to determine which candidate needs can best be supported by data. In so doing, we will assume and try to demonstrate that psychological needs are particular qualities of experience that all people require to thrive (Deci & Ryan, in press; Sheldon, Ryan, & Reis, 1996). Thus, our definition views needs primarily as necessary inputs rather than as driving motives, leaving open the possibility that particular motives may not satisfy organismic needs, even if they are attained (Sheldon & Kasser, 1998). As a primary criterion for evaluating the importance of candidate needs, we will measure the extent to which each need accompanies the "most satisfying events" that people describe as having occurred within varying periods of time.

As can be seen, our chosen methodology relies in part on an analysis of natural language: What do people mean when they say some experience was satisfying? By starting with self-identified

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satisfying events and then examining what psychological characteristics are most salient within them, we hope to gain an important new window on the fundamental needs question, in the same way that lexical or natural-language analyses have provided a new window on the fundamental-traits question (Saucier & Goldberg, 1995). It is also worth noting that our methodology is of a mixed idiographic-nomothetic type (Emmons, 1989). That is, we started with participants' unique experiential memories, giving the resulting data considerable personological meaning and validity. Despite this, we were also able to make numerical comparisons between participants and between needs, by focusing on the nomothetic ratings that participants made regarding the personal events they described. Such mixed methodologies have become increasingly useful and popular within contemporary personality psychology (Little, 1999).

### Identifying Candidate Needs

To derive a set of candidate needs for the study, we drew from a variety of psychological theories. As a foundation we used Deci and Ryan's self-determination theory of motivation (1985, in press), which specifies that people want to feel effective in their activities (competence), to feel that their activities are self-chosen and self-endorsed (autonomy), and to feel a sense of closeness with some others (relatedness). Of course, competence is a well-known need, reflected in White's concept of mastery (1959), Bandura's concept of self-efficacy (1997), and Atkinson's concept of achievement motivation (1964). Similarly, the proposal that humans need to feel a sense of relationship with important others is also relatively uncontroversial (Baumeister & Leary, 1995; Reis & Patrick, 1996). Although autonomy is somewhat more controversial and easily misunderstood (Ryan & Deci, 2000; Sheldon et al., 1996), it is featured in many other theories besides Deci and Ryan's, including Murray's (1938), Erickson's (1963), and Roger's (1963) seminal theories of personality.

We also drew from Maslow's theory of personality (1954) and its set of five fundamental needs: physical health, security, self-esteem, love-belongingness, and self-actualization. In brief, Maslow proposed that people need to feel that the biological requirements of their physical organism are satisfied, a sense of order and predictability within their lives, a sense of personal worthiness and importance, a sense of love and affection with important others, and that they are moving toward an ideal world or version of themselves.

Notably, Maslow's conception of a love or belongingness need is essentially equivalent to Deci and Ryan's relatedness need in that both address feelings of interpersonal connection. Thus the two models are redundant on this score. However, we believe that there are important differences between Deci and Ryan's autonomy and competence needs and Maslow's self-actualization and self-esteem needs (Deci & Ryan, in press). *Autonomy* refers to a quality of self-involvement in momentary behavior, whereas *self-actualization* refers to a sense of long-term growth; *competence* refers to attaining or exceeding a standard in one's performance, whereas *self-esteem* refers to a more global evaluation of the self. Thus, we assessed these four needs separately. In sum, the two models together suggest seven different psychological needs that might be tested: autonomy, competence, relatedness, physical, security, self-esteem, and self-actualization.

In addition, we consulted Epstein's cognitive-experiential self-theory (1990), which specifies four needs or functions that all individuals must satisfy: self-esteem, relatedness, pleasure (vs. pain), and self-concept consistency. Of course, self-esteem and relatedness were already discussed above. Also, we view Epstein's self-consistency need as roughly equivalent to Maslow's need for security in that the primary function of self-consistency, according to Epstein, is to bring a sense of stability to the individual. Thus, Epstein's model supplies one new candidate need to our list, the need for pleasurable stimulation, bringing the total number of candidates to eight.

Finally, we drew from a prominent lay theory of human needs, namely the "American dream" assumption that happiness results when individuals acquire popularity-influence and money-luxuries (Derber, 1979). Indeed, the ability to "win friends and influence people" (Carnegie, 1936) has long been extolled as a route to a prosperous and thus happy life. Despite such common beliefs, recent work indicates that these two experiential commodities may not be so important after all, and they may in fact may be negatively related to well-being (Carver & Baird, 1998; Kasser & Ryan, 1993, 1996; King & Napa, 1998). Nevertheless, we included them in order to test these recent findings in a new way and to allow prominent cultural, as well as psychological, theories of needs to have their say.

Notably, the above set of 10 needs (autonomy, competence, relatedness, physical thriving, security, self-esteem, self-actualization, pleasure-stimulation, money-luxury, and popularity-influence) also represent many other prominent assumptions and theories within the literature. For example, mainstream social psychology often assumes two basic psychological needs or motives: self-enhancement and self-consistency (Swann, 1990). These are approximately represented in our set by *self-esteem* and *security*. The need for *pleasurable stimulation*, derived from Epstein's (1990) model, encapsulates the single most basic motive according to hedonistic philosophies. Baumeister and Leary (1995) have argued for a different singularly important need, belongingness, which is represented in our set as *relatedness*. Terror management theory also posits a single superordinate need, for *self-esteem* (Greenberg, Pyszczynski, & Solomon, 1995), as does classic humanistic psychology, for *self-actualization* (Rogers, 1963); both of these are included in our set of 10. Evolutionary or adaptationist perspectives on personality often postulate inborn motives to attain material and social dominance (Buss, 1997; Hogan, 1996), which are represented herein as *money-luxury* and *popularity-influence*. Finally, in our choice of items for Maslow's growth or self-actualization need, we attempted to give some representation to the fundamental need for meaning that has been proposed by so many theorists (Baumeister, 1991; Frankl, 1997). In sum, although we do not claim to have captured all potential psychological needs with these 10 candidates, we believe the chosen set has considerable range and represents a variety of important theories.

### Evaluating the Relative Importance of Candidate Needs

We used two basic criteria in trying to determine the most fundamental needs. First, which candidate qualities of experience are rated as most present or salient within peoples' "most satisfying experiences?" Presumably, those qualities of experience that are in truth most satisfying (and perhaps actually needed by humans) will be most strongly represented within participants'

ratings of the naturally occurring peak experiences they identify. As discussed above, this assumption relies on a natural-language criterion: Needs will be defined as the qualities of experience most closely associated with participant-designated satisfying events. In contrast, candidate needs that are not salient within satisfying events might with some justification be eliminated from further consideration.

As a second criterion for identifying needs, we asked, "Which qualities of experience best predict variations in positive and negative affect associated with the event described?" Here, we rely on the assumption of Deci and Ryan (in press), Baumeister and Leary (1995), and others—that satisfied needs should promote well-being and psychological thriving in the same way that proper fertilization promotes the growth of plants. A second and related reason to use affect and mood variables as criteria is that they offer a relatively value- and context-free window on psychophysical thriving (Ryff & Singer, 1998). Presumably, all humans have the same basic emotional systems, and arguably any person feeling much positive mood and little negative mood is thriving.

Reis et al. (2000), Sheldon and Bettencourt (2000), Sheldon and Elliot (1999), and Sheldon et al. (1996) all used such affect-based indicators of thriving in their more limited studies of psychological needs. However, the current study moves considerably beyond these past studies, not only by sampling satisfying experiences directly but also by examining a large set of needs derived from a wide assortment of theories, not just the three needs derived from Deci and Ryan's theory.

Notably, this second (affect-based) criterion supplies a more indirect test of the importance of candidate needs, one that does not rely on participants' explicit beliefs about the meaning of *satisfying*. In theory, the two criteria could yield different results (i.e., the experiential qualities that participants rate as strongest or most salient within satisfying events may not be the same qualities that are most associated with the presence of positive affect and the absence of negative affect during those events). To find convergences such that the same candidate needs emerge as most important by both criteria would nicely support those candidacies and would also support our general approach to identifying needs.

### Overview of Studies and Hypotheses

Study 1 had three goals. First, we tested our item set for measuring the 10 candidate needs. Second, we compared the relative salience of the 10 qualities of experience within the "most satisfying event of the past month" described by participants and compared the 10 needs as predictors of event-related positive and negative affect. Third, we examined a trait measure of the strength of each of the 10 needs, to see whether individual differences in need strengths moderate the effect of the corresponding need variables on positive and negative affect. This latter hypothesis is suggested by "matching" theories of satisfaction, in which experiences are most rewarding when they match the preferences of the experiencer (Harackiewicz & Sansone, 1991; Oishi, Diener, Suh, & Lucas, 1999). Finding no support for a matching hypothesis would tend to support a universalist perspective, which assumes that "true" needs are those that influence every person's well-being, regardless of the person's stated preferences (Deci & Ryan, in press).

In Study 2 we asked a U.S. sample and a South Korean sample to describe "the most satisfying event of the last week." The inclusion of the U.S. sample enabled us to examine the replicability of the Study 1 results, and the instructions to think of the "last week" enabled examination of the replicability of results to a shorter time frame. More important, this design allowed us to examine the generalizability of effects to a collectivist culture. Because recent cross-cultural work suggests that psychological motives might differ substantially in collectivistic cultures (Markus, Kitayama, & Heiman, 1996), it was important to include such a sample to explore the potential "universality" of identified needs. Finally, in Study 3 we examined the replicability of Study 1 and Study 2 results to a longer time frame (the whole semester) and also examined the replicability of results when participants reported on their most unsatisfying events, as well as their most satisfying events.

On the basis of our own past findings (Reis et al., 2000, Sheldon & Elliot, 1999, Sheldon et al., 1996) and self-determination theory (Deci & Ryan, 1985), we expected that autonomy, competence, and relatedness would all emerge as important needs (Deci & Ryan, in press). That is, they should have among the highest mean scores in peoples' ratings of satisfying events, and they should all be significantly and uniquely associated with event-related affect. On the basis of Deci and Ryan's further claim that these three needs are universal and important within every sphere of life, we expected to find these patterns within every time frame examined, and also within every culture examined. Notably, our view predicts only that this *set* of needs should emerge at or near the top, and it does not make predictions about the ordering of needs within that set; thus, the relative importance of autonomy, competence, and relatedness may well vary among contexts, time frames, and cultures. Finally, on the basis of Kasser and Ryan's prior (1993, 1996) findings, we also expected that popularity-influence and money-luxury would be least important. No other a priori predictions were ventured.

### Study 1

#### Method

#### Participants and Procedure

Participants were 322 students in introductory psychology at the University of Missouri who participated in the research to satisfy an experimental participation requirement (7 participants were later excluded from the analysis because they did not follow instructions). Participants attended group sessions run by a trained research assistant in which they completed a single questionnaire packet containing all study materials.

#### Measures

**Most satisfying event.** At the beginning of the questionnaire, participants read the following:

Now, we ask you to consider the past month of your life. Think back to the important occurrences of this period of time. What we want you to do is bring to mind the *single most personally satisfying event* that you experienced during the last month (emphasis in the original). We are being vague about the definition of "satisfying event" on purpose.

Table 1

*Study 1: Need-Satisfaction Items With Factor Loadings Greater Than .45*

Item (responses to "During this event I felt...")	Factor								
	1	2	3	4	5	6	7	8	9
1. Autonomy									
That my choices were based on my true interests and values.	.66								
Free to do things my own way.	.64								
That my choices expressed my "true self."	.72								
2. Competence									
That I was successfully completing difficult tasks and projects.		.86							
That I was taking on and mastering hard challenges.		.82							
Very capable in what I did.		.49							
3. Relatedness									
A sense of contact with people who care for me, and whom I care for.			.80						
Close and connected with other people who are important to me.			.85						
A strong sense of intimacy with the people I spent time with.			.77						
4. Self-actualization—meaning									
That I was "becoming who I really am."				.78					
A sense of deeper purpose in life.				.76					
A deeper understanding of myself and my place in the universe.				.81					
5. Physical thriving									
That I got enough exercise and was in excellent physical condition.					.69				
That my body was getting just what it needed.					.73				
A strong sense of physical well-being.					.66				
6. Pleasure—stimulation									
That I was experiencing new sensations and activities.					.57				
Intense physical pleasure and enjoyment.					.78				
That I had found new sources and types of stimulation for myself.					.61				
7. Money—luxury									
Able to buy most of the things I want.						.77			
That I had nice things and possessions.						.69			
That I got plenty of money.						.81			
8. Security									
That my life was structured and predictable.							.69		
Glad that I have a comfortable set of routines and habits.							.70		
Safe from threats and uncertainties.							.48		
9. Self-esteem									
That I had many positive qualities.								.78	
Quite satisfied with who I am.								.77	
A strong sense of self-respect.								.80	
10. Popularity—influence									
That I was a person whose advice others seek out and follow.									.58
That I strongly influenced others' beliefs and behavior.									.79
That I had strong impact on what other people did.									.82

because we want you to use your own definition. Think of "satisfying" in whatever way makes sense to you. Take a couple minutes to be sure to come up with a very impactful experience.

The event descriptions that were provided by participants in response to these instructions were quite diverse, ranging from achievement to familial, to sexual, to spiritual, and to many other domains.<sup>1</sup>

Participants were next asked to make ratings about the event, concerning "a variety of complex thoughts and feelings." Hoping to encourage participants to differentiate carefully between different types of positive feelings, we asked them to "be as discriminating as you can in making these ratings." Participants then responded to 30 descriptive statements, 3 for each of the 10 postulated needs, using a 1 (*not at all*) to 5 (*very much*) scale. All descriptions began with the same stem: "During this event I felt..." Saliency scores were computed for each of the 10 candidate needs by averaging the 3 relevant items. The specific item-set, which was derived from theoretical analysis and pilot work, is presented in Table 1.

Participants also rated the extent to which they felt each of 20 different moods during the event, using the same scale. Specifically, they completed the Positive Affect/Negative Affect scale (PANAS) regarding the event (Watson, Tellegen, & Clark, 1988). The PANAS contains mood adjectives

such as *scared*, *hostile*, *inspired*, and *proud*. Positive and negative affect scores were computed by averaging the appropriate ratings and were treated as outcome variables. In addition, an affect-balance score was computed by subtracting the negative affect score from the positive affect score (Bradburn, 1969). This score served as a third, summary outcome variable.

*Assessing individual differences in need preferences.* In an attempt to assess individual differences in the strengths of the 10 needs, we used the pairwise comparison technique of Oishi, Schimmack, Diener, and Suh (1998). In their research, definitions of each of 10 values were presented to participants, who then indicated their preferences within every possible pairing of values. The advantage of this comparison method is that the influence of response sets is minimized, because the method focuses on the relative strength of responses compared with

<sup>1</sup> Although we attempted to develop content-coding schemes for categorizing the events into specific types, the task proved too difficult given that many events touched on multiple possible content categories or were ambiguous with respect to potential coding categories.

other responses made by the subject, excluding mean levels of responding. In the current work, we supplied participants with definitions of each of our 10 candidate needs (these definitions can be found in the Appendix *a*) and then asked them to rate their relative preference within each possible pairing, using a scale of -2 (*first is much more important*) to 0 (*each is equally important*) to +2 (*second is much more important*). Participants made 45 ratings altogether, and we computed 10 different need-strength variables by summing the level of preference expressed for each candidate need as compared with the other 9 candidates (see Oishi et al., 1998, for further scoring details). The measure was given prior to the "most satisfying event" measures.

## Results

### Factor Analysis

We first conducted a principal-components analysis of the 30 event-related need-satisfaction variables, using a varimax rotation. Table 1 presents the resulting solution, including all factor loadings of .45 or greater.<sup>2</sup> Only 9 factors with eigenvalues of 1.0 or greater emerged, rather than the expected 10. Inspection of the loadings revealed that the three pleasure-stimulation items and the three physical thriving items all loaded on the same factor (see Table 1). Despite their intercorrelation, we computed a separate score for these two candidate needs on the basis of our *a priori* theoretical model.<sup>3</sup>

### Substantive Analyses

*Mean differences in the salience of candidate needs.* Table 2 presents the means for each of the 10 needs, in rank order. Differences between these means were tested using paired-sample *t* tests. Given the number of tests performed, a significance level of .01 was adopted for these analyses. As can be seen, self-esteem, relatedness, and autonomy emerged in a three-way tie at the top of the list, suggesting that these are the most salient experiential elements of "satisfying experiences." Competence was close behind, in second position, and thus our hypothesis based on self-determination theory—that autonomy, competence, and relatedness would be among the most important experiential characteristics—received good support. Pleasure-stimulation was in the third position, consistent with Epstein's (1990) assumptions and with hedonic philosophy

Table 2  
Study 1: Mean Salience of Each Candidate Need Within  
Participants' Most Satisfying Experiences of the Last Month

Candidate need	<i>M</i>	<i>SD</i>
Self-esteem	4.08 <sub>a</sub>	0.90
Relatedness	3.99 <sub>a</sub>	1.13
Autonomy	3.98 <sub>a</sub>	0.87
Competence	3.74 <sub>b</sub>	0.98
Pleasure-stimulation	3.53 <sub>c</sub>	1.08
Physical thriving	3.25 <sub>d</sub>	1.13
Self-actualization-meaning	3.23 <sub>d</sub>	1.13
Security	3.03 <sub>e</sub>	0.90
Popularity-influence	2.89 <sub>e</sub>	1.02
Money-luxury	2.37 <sub>f</sub>	1.08

Note. Means not sharing subscripts are significantly different from each other at  $p \leq .01$ . Means could range from 1.00 to 5.00.

Table 3

Study 1: Correlations of Candidate Needs  
With Event-Related Affect

Candidate need	Positive affect	Negative affect	Affect balance
Self-esteem	.43**	-.27**	.43**
Autonomy	.31**	-.24**	.34**
Competence	.39**	-.05	.26**
Relatedness	.21**	-.16**	.23**
Pleasure-stimulation	.32**	-.02	.20**
Physical thriving	.34**	-.02	.20**
Self-actualization-meaning	.24**	.00	.13*
Security	.21**	-.01	.12*
Popularity-influence	.14**	.13*	-.01
Money-luxury	.05	.21**	-.12*

\* $p < .05$ . \*\* $p < .01$ .

more generally. Physical thriving and self-actualization-meaning emerged in the fourth position, accounting for the third and fourth of Maslow's five posited needs. The significant mean difference between physical thriving and pleasure-stimulation is noteworthy because, as presented above, the items from these two needs all loaded on the same factor; here, however, the two needs are distinguishable. Security was in the next position, accounting for the final needs in both Maslow's (fivefold) and Epstein's (fourfold) postulated sets. Popularity-influence and money-luxury brought up the rear, supporting our hypothesis, based on self-determination theory, that these two aspects of the "American dream" may not be so desirable after all (Kasser & Ryan, 1993, 1996).

*Associations of need satisfaction with event-related affect.* Table 3 presents the correlations of each of the 10 satisfaction scores with event-related positive affect and negative affect, and also with the composite affect-balance score. As can be seen, the very same needs that emerged as most important by the first criterion also emerged as paramount by this second criterion. Specifically, the four most strongly endorsed needs—self-esteem, autonomy, competence, and relatedness—were also found to be most strongly associated with high-positive and low-negative emotion. Furthermore, pleasure-stimulation, physical health, self-actualization-meaning, and security-control—the middle four needs in Table 1—were less strongly associated with high-positive and low-negative affect. Finally, popularity-influence and money-luxury—the two most weakly endorsed experiences in Table 1—were also unrelated or even negatively related to affect balance, consistent with our hypotheses and the "dark side of the American dream" effects described by Kasser and Ryan (1993, 1996).

<sup>2</sup> We have not presented cross-loadings in this table, in order to simplify the presentation. For the record, one item cross-loaded more than .40 on an unintended scale (i.e., "I felt very capable in what I did," a competence item, cross-loaded .44 on self-esteem). Ten items cross-loaded more than .30 on unintended scales, and the remaining cross-loadings were all less than .30.

<sup>3</sup> Notably, our approach does not require that all candidate needs suggested by existing theories emerge as empirically distinct; obviously, different theories may sometimes converge on the same basic need from different conceptual angles.

*Regression comparisons.* To test our specific hypotheses concerning the importance of autonomy, competence, and relatedness, we conducted a series of simultaneous regressions. In these analyses, each of the event-related affect variables was regressed in turn on these three candidate needs. All three of the needs postulated by self-determination theory significantly predicted positive affect (autonomy,  $\beta = .16$ ; competence,  $\beta = .37$ ; relatedness,  $\beta = .17$ ; all  $ps < .01$ ). Only autonomy predicted negative affect ( $\beta = -.21$ ,  $p < .01$ ). Thus, as in past work, need satisfaction appears to be more important for producing positive affect than for reducing negative affect (Sheldon & Bettencourt, 2000; Sheldon et al., 1996). Most important, as hypothesized, all three needs postulated by self-determination theory predicted the aggregate affect-balance variable (autonomy,  $\beta = .23$ ,  $p < .01$ ; competence,  $\beta = .21$ ,  $p < .01$ ; relatedness,  $\beta = .14$ ,  $p < .05$ ).

Next, we conducted an analysis in which all 10 candidate needs were entered simultaneously as predictors of the affect-balance variable. This most stringent test removes all common variance shared by the 10 candidates in order to see which, if any, contribute unique variance in the prediction of positive affective tone. In this analysis, Autonomy, Competence, and Relatedness all emerged as significant ( $\beta s = .17$ ,  $.12$ , and  $.12$ , respectively,  $ps < .05$ ). In addition, Self-Esteem contributed unique predictive variance ( $\beta = .28$ ,  $p < .01$ ). It is interesting that money-luxury emerged as a negative predictor in this analysis ( $\beta = -.17$ ,  $p < .01$ ), again supporting the "dark side" hypothesis. No other need candidates were significant in this analysis.

*Individual differences in need preference as a moderator variable.* Finally, we looked at the moderating influence of each of the individual-difference measures of need strength on the event-related need salience to event-related affect relations. As discussed above, a "matching" hypothesis would predict that those individuals who report that they strongly prefer a particular experience should benefit the most, in terms of resultant affective tone, from experiences of that type. To test this, we computed 10 product terms by multiplying each of the centered need-preference variables by the corresponding event-related satisfaction score (Aiken & West, 1991). We then conducted a regression analysis using the affect-balance score as the dependent measure. As above, all 10 satisfaction scores were entered at the first step, then the 10 need-preference scores were entered at the second step, and finally the 10 product terms were entered at the third step.

None of the need-preference variables was significant at the second step. At the third step, only one significant interaction effect emerged, for self-actualization-meaning ( $p < .02$ ). The coefficient was positive, indicating that feelings of growth and meaningfulness are more strongly associated with positive event-related affect when the person especially values such feelings. However, the set of 10 product terms as a whole did not add significant predictive variance to the equation ( $\Delta R^2 = .03$ ,  $p = .21$ ). Thus, these results do not provide much support for the matching hypothesis.

## Discussion

The results from Study 1 provide encouraging support for our method of approaching questions concerning fundamental psychological needs. With the exception of the pleasure-stimulation and physical thriving needs, participants were able to discriminate

clearly among the items representing the 10 candidate needs. More important, strong convergence was observed between our two distinct criteria for identifying needs. That is, the same candidate needs that were rated as strongly present in satisfying experiences were also strongly positively correlated with pleasure in that experience. This convergence suggests that participants really do know "what's satisfying about satisfying events."

Study 1 also provided encouraging support for our hypotheses based on self-determination theory, concerning which needs are most fundamental. First, the trio of autonomy, competence, and relatedness emerged within the top four in terms of salience. In other words, it appears that when people are asked to bring to mind deeply satisfying experiences, they think of experiences in which they felt strongly autonomous, competent, or related to others. Second, each of the three needs postulated by self-determination theory predicted independent variance in event-related affect, and all three continued to do so even when the other seven needs were in the equation. Our final hypothesis based on self-determination theory also received support in Study 1, that popularity-influence and money-luxury are least important and may even be negative for well-being (Kasser & Ryan, 1993, 1996). Of interest is that self-esteem also emerged as an important need by our criteria, consistent with some contemporary theories of needs (i.e., Greenberg et al., 1995). This finding was not predicted by self-determination theory.

Study 1 had two important limitations. First, it addressed only satisfaction within a single time frame (i.e., "events within the last month"). In fact, time frame can have an important influence on mood and affective reports (Suh, Diener, & Fujita, 1996), as different types of memory processes may be involved in immediate versus more long-term recall (Thomas & Diener, 1990). Thus, to better establish the strength and differential influence of identified needs, it was necessary to replicate the effects using a different time frame. A second weakness of Study 1 is that participants came from a single (highly individualistic) culture, the United States. To begin to establish cross-cultural replicability for the identified needs, it was necessary to reproduce the effects within a more collectivist culture. In Study 2 we addressed both of these issues.

## Study 2

### Method

#### Participants and Procedure

Two samples were used for Study 2. The U.S. sample consisted of 152 students in introductory psychology at the University of Missouri who participated in the research to satisfy an experimental participation requirement. The South Korean sample consisted of 200 students in introductory psychology at Hanyang University in South Korea, who also participated to satisfy an experimental requirement. Both universities are large, with more than 15,000 students. Participants attended group sessions run by trained research assistants in which they completed a questionnaire packet containing all experimental materials.

#### Translation

The English questionnaire was translated into Korean by Youngmee Kim, a native Korean. A back-translation was then accomplished by a second Korean speaker. Working from the back-translation, Kennon M.

Sheldon and Youngmee Kim collaborated to create a final South Korean version of the questionnaire.

### Measures

Instructions for identifying a "most satisfying event" were identical to those in Study 1, with one exception: All participants were asked to consider the past week, rather than the past month, of their lives. The resulting event descriptions again showed a great deal of diversity.

Participants next responded to the same 30 descriptive statements used in Study 1, using the same stem: "During this event I felt . . ." Salience scores were computed for each of the 10 candidate needs by averaging the 3 relevant items. Participants also rated the extent to which they felt the 20 PANAS moods during the event, using a scale of 1 (*not at all*) to 5 (*very much*). Positive and negative affect scores were computed by averaging the appropriate ratings, and an affect-balance variable was computed by subtracting the negative from the positive affect score.

Participants in Study 2 also indicated their family income status on a scale ranging from 1 = *much below* to 5 = *much above* their country's median income. (Of course, the monetary amounts associated with scale points differed in the two cultures.) Family income was used as a control variable in regression analyses in an attempt to partial out any effects of socioeconomic status.

### Results

#### Mean Differences in the Salience of Candidate Needs

Table 4 presents means and standard deviations for each candidate need separately for each sample. Of interest is that salience scores in general were lower in these two samples than in Study 1, probably because the events referred only to the past week and not the past month. In terms of salience ratings for the candidate needs, results for the U.S. sample were quite similar to those found in Study 1. Specifically, autonomy, competence, and relatedness again emerged within the top four needs, along with self-esteem. As in Study 1, all four of these candidate needs were more strongly endorsed than those in a middle group, which included pleasure-

stimulation, self-actualization-meaning, and physical thriving. Notably, popularity-influence also fell in this middle group, rather than being in the lowest group, as in Study 1. Once again, however, money-luxury appeared at the very bottom of the list.

In the South Korean sample, as in the two U.S. samples, autonomy, competence, and relatedness were all among the top needs. Thus, our primary hypotheses again received good support. In addition, self-esteem emerged near the top, as did pleasure-stimulation. Notably, however, the exact ordering of these needs was somewhat different within the South Korean sample. As can be seen, relatedness topped the list, perhaps consistent with the collectivism that characterizes South Korean culture (Markus et al., 1996). Self-esteem occupied the second position, seemingly at odds with recent findings that self-esteem and self-enhancement are not as important within Asian cultures (Heine & Lehman, 1997; Kitayama, Markus, & Lieberman, 1995). Autonomy, competence, and pleasure-stimulation occupied the third position. Self-actualization-meaning, security, and popularity-influence occupied the fourth position, forming a middle group very similar to those found in the U.S. samples. Physical thriving occupied the fifth position, and as in the U.S. samples, money-luxury was last on the list.

Table 4 also contains the results of 10 matched group *t* tests that compared the U.S. and South Korean means. As can be seen, despite the large sample sizes and potential translation difficulties, the two samples did not differ on the extent to which 5 of the 10 candidate experiences accompanied "satisfying events," namely autonomy, competence, physical thriving, self-actualization-meaning, and popularity-influence. However, South Koreans did report a greater sense of relatedness and also of security, pleasure or stimulation, and money or luxuries in their satisfying events, compared with the U.S. sample. In addition, South Koreans reported a relatively weaker sense of self-esteem during the event, compared with the U.S. sample. Thus, in relation to U.S. participants at least, recent findings regarding the weaker salience of self-esteem in Asian cultures were confirmed (Kitayama et al., 1995).

Table 4  
Study 2: Mean Salience of Each Candidate Need Within  
Participants' Most Satisfying Experiences  
of the Last Week, by Sample

Candidate need	U.S. sample		South Korean sample		<i>t</i> (350)
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Self-esteem	3.65 <sub>a</sub>	1.06	3.23 <sub>b</sub>	0.91	4.01**
Relatedness	3.21 <sub>b</sub>	1.42	3.65 <sub>a</sub>	1.07	3.31**
Autonomy	3.12 <sub>b</sub>	1.18	3.01 <sub>c</sub>	0.95	1.03
Competence	2.98 <sub>b</sub>	1.14	2.91 <sub>c</sub>	1.09	0.61
Pleasure-stimulation	2.60 <sub>c</sub>	1.08	2.95 <sub>c</sub>	0.90	3.05**
Physical thriving	2.49 <sub>c</sub>	1.16	2.42 <sub>c</sub>	1.04	0.54
Self-actualization-meaning	2.54 <sub>c</sub>	1.13	2.69 <sub>d</sub>	1.02	1.30
Security	2.46 <sub>c</sub>	1.02	2.70 <sub>d</sub>	0.88	2.37*
Popularity-influence	2.50 <sub>c</sub>	1.02	2.71 <sub>d</sub>	0.96	1.93
Money-luxury	2.14 <sub>d</sub>	1.05	2.35 <sub>e</sub>	0.91	2.02*

Note. Means within columns not sharing subscripts are significantly different from each other at  $p \leq .01$ . The fifth column tests the differences between the means of the two samples.

\* $p < .05$ . \*\* $p < .01$ .

#### Associations of Need Satisfaction With Event-Related Affect

Table 5 contains the correlations of each of the candidate needs with event-related positive affect, negative affect, and affect balance, separately by sample. Results for the U.S. sample were very consistent with the results of Study 1 in that autonomy, competence, relatedness, and self-esteem were most strongly associated with positive affect and affect balance. Furthermore, autonomy and relatedness were again negatively associated with negative affect. Pleasure-stimulation, physical thriving, self-actualization-meaning, popularity-influence, and security were also (more weakly) associated with positive affective tone. Diverging from Study 1, in this sample the negative association between money-luxury and affect balance did not reach significance.

The associations of the need-satisfaction variables with positive affect were in general stronger within the South Korean sample; in fact, every correlation was significant, for both positive affect and for the aggregate affect-balance variable. Two findings regarding negative affect are noteworthy: Experiences of competence and

Table 5  
*Study 2: Correlations of Candidate Needs With Event-Related Affect, by Sample*

Candidate need	U.S. sample			South Korean sample		
	Positive affect	Negative affect	Affect balance	Positive affect	Negative affect	Affect balance
Self-esteem	.36**	-.11	.29**	.57**	-.14 <sup>†</sup>	.51**
Autonomy	.49**	-.21**	.43**	.51**	-.13**	.46**
Competence	.39**	-.03	.32**	.59**	.16**	.31**
Relatedness	.24**	-.22**	.29**	.29**	-.22*	.37**
Pleasure-stimulation	.27**	.00	.16*	.48**	-.03	.36**
Physical thriving	.16	.02	.08	.38**	-.10	.35**
Self-actualization-meaning	.23**	.02	.13	.47**	.12 <sup>†</sup>	.25**
Security	.32**	-.14	.28**	.42**	-.23**	.48**
Popularity-influence	.24**	.01	.14 <sup>†</sup>	.36**	-.05	.30**
Money-luxury	.00	.11	-.07	.24**	.00	.17*

\* $p < .05$ . \*\* $p < .01$ . <sup>†</sup> $p < .10$  (marginally significant).

experiences of self-actualization-meaning were both positively predictive of negative affect.

To test our specific hypotheses concerning the importance of autonomy, competence, and relatedness, the three event-related affect variables were simultaneously regressed on these three candidate needs, separately for each sample. In the U.S. sample, all three quantities accounted for significant variance in positive affect (competence,  $\beta = .44$ ; autonomy,  $\beta = .30$ ; relatedness,  $\beta = .15$ ; all  $ps \leq .05$ ). This was also the case in the South Korean sample (competence,  $\beta = .46$ ; autonomy,  $\beta = .25$ ; relatedness,  $\beta = .17$ ; all  $ps < .05$ ). No significant effects were observed on negative affect in the U.S. sample, whereas in the South Korean sample competence was positively associated with negative affect ( $\beta = .26$ ,  $p < .01$ ), whereas autonomy and relatedness were negatively associated with negative affect ( $\beta = -.19$  and  $-.20$ , both  $ps < .01$ ). Finally, in the U.S. sample, autonomy, competence, and relatedness independently predicted the aggregate affective-balance variable ( $\beta s = .26$ ,  $.28$ ,  $ps < .01$ , and  $\beta = .19$ ,  $p < .05$ , respectively). Similarly, in the South Korean sample, all three experiences postulated as needs by self-determination theory predicted affect balance ( $\beta s = .33$ ,  $.14$ , and  $.27$ , respectively;  $ps < .01$ ,  $.05$ , and  $.01$ , respectively).

Next, we conducted analyses in which all 10 candidate needs were entered simultaneously as predictors of the aggregate affect-balance variable, separately for each sample. Again, this most stringent test removes all variance shared by the 10 candidates to see which, if any, contribute unique variance in the prediction of affective tone. In the U.S. sample, autonomy, competence, and relatedness all emerged as significant ( $\beta s = .29$ ,  $.25$ , and  $.21$ ; all  $ps < .05$ ), and no other candidate needs contributed significant predictive variance. In the South Korean sample, autonomy and relatedness emerged as significant ( $\beta s = .26$  and  $.20$ , respectively; both  $ps < .01$ ), whereas competence evidenced a nonsignificant trend ( $\beta = .10$ ,  $p = .18$ ). In addition, self-esteem ( $\beta = .23$ ,  $p < .01$ ) and security ( $\beta = .25$ ,  $p < .01$ ) contributed significant positive variance within the latter equation, and money-luxury ( $\beta = -.22$ ,  $p < .01$ ) was a negative predictor.

We then tested for significant interactions between culture and the 10 candidate needs, in relation to the affect-balance variable. Specifically, we conducted a hierarchical regression using the

entire sample of 352 participants, in which all 10 (centered) need candidates were entered at Step 1, followed by a dummy variable at Step 2 indicating to which sample the participant belonged (U.S. or South Korean), followed by a set of 10 product terms at Step 3, which represented the interaction of culture with each of the 10 need candidates. At Step 1, autonomy, competence, and relatedness were all significant ( $\beta s = .27$ ,  $.17$ , and  $.15$ , respectively; all  $ps < .01$ ). In addition, self-esteem and security manifested positive effects ( $\beta s = .18$  and  $.15$ , both  $ps < .01$ ), and money-luxury had a negative effect ( $\beta = -.15$ ,  $p < .01$ ). At Step 2 the dummy variable representing the subsample was significant ( $\beta = -.14$ ,  $p < .05$ ), indicating that the South Koreans were somewhat lower on event-related affect balance ( $M = 1.63$  vs.  $M = 1.32$ ; although South Koreans were no different in event-related negative affect, they were much lower in positive affect). At Step 3, none of the 10 interaction product terms were significant; furthermore, the set as a whole did not contribute significant variance to the equation ( $\Delta R^2 = .02$ ,  $p = .34$ ), suggesting that the influence of these 10 qualities of experience on affect balance did not vary as a function of participants' cultural membership.

A final set of analyses examined the family-income variable. Americans and South Koreans did not differ on this variable ( $M = 2.95$  vs.  $M = 2.89$ , respectively,  $ns$ ). For the whole sample, family income was associated with only 1 of the 10 need-salience variables, namely money-luxury ( $r = .20$ ,  $p < .01$ ). Of interest is that this association was far stronger in the South Korean sample ( $r = .33$ ,  $p < .01$ ) than in the U.S. sample ( $r = .07$ ,  $ns$ ), indicating that wealthier South Korean students perceive money or luxury to be quite salient in very satisfying events, whereas wealthier American students do not. Entering family income as a control variable did not substantially alter any of the regression results above, however.

### Discussion

The results for the U.S. sample in Study 2 replicated the results for Study 1, but for a shorter time frame (i.e., most satisfying event of the last week instead of the last month). In terms of our first criterion for identifying needs, based on mean levels of endorsement, autonomy, competence, and relatedness again emerged at

the top of the list, as did self-esteem. Money-luxury was again at the bottom of the list, and the other candidates again fell in the middle. This same general ordering of needs was again found using our second criterion for identifying needs, namely association with event-related affect. Specifically, autonomy, competence, relatedness, and self-esteem were all unique predictors of positive affective tone, whereas money-luxury was again associated with negative affect.

Perhaps the most important finding of Study 2 was the emergence of similar results within the South Korean sample. Just as in the two U.S. samples, autonomy, competence, relatedness, and self-esteem emerged as the most important set, both in terms of mean differences and association with event-related affect. The findings regarding autonomy are especially noteworthy given recent challenges to self-determination theory's assumption that autonomy or perceived choice is a universal need (Iyengar & Lepper, 1999; Markus et al., 1996). It appears, here, that autonomy is equally important in the U.S. and South Korea, at least for characterizing what people consider satisfying and for predicting positive affect-balance.

Despite the strong convergences across the U.S. and South Korean samples, there were some meaningful differences. Feelings of relatedness were especially salient within South Koreans' "most satisfying experiences," consistent with South Korea's status as a collectivist culture and with the findings of Kwan, Bond, and Singelis regarding feelings of harmony (1997). Furthermore, feelings of self-esteem were less salient in Korea compared with the U.S., consistent with other recent work on the reduced importance of self-esteem in collectivist cultures (Kitayama et al., 1995). Notably, however, self-esteem still came in second within the South Korean hierarchy, suggesting that it does have importance. In sum, then, although the same set of needs emerged at the top in both samples, the ordering of needs within this set varied considerably. This suggests that the universalist and the cultural constructivist positions may both be correct. That is, it may be that certain needs are universal to humans in general, but the relative salience that people place on them depends on the extent to which their cultures encourage and support those needs.

### Study 3

We next conducted a third study to extend the research presented thus far. First, we examined the "most satisfying event of the semester" to ensure generalizability of the effects to an even longer time frame. In fact, it is not difficult to think of reasons why different patterns might emerge when participants reflect back on long versus short periods of time. For example, self-actualization-meaning might be expected to be most salient within a more global frame of reference, whereas pleasure-stimulation might be most salient when a person considers short-term satisfactions. Thus, to clearly replicate Study 1 and 2 results in this much longer time period would help establish that the determinants of satisfaction do not vary according to the temporal scale of the event the person describes.

A second extension of Study 3 was to approach the question of fundamental needs from the opposite direction, namely by asking participants to describe the most unsatisfying event they experienced during the semester and then rate what was missing from the experience. We did this because psychological needs can be con-

sidered from a deficit perspective (i.e., as qualities that, if lacking, may lead to ill-being) as well as from an enhancement perspective (i.e., as qualities that, if present, may lead to well-being; Maslow, 1954). Conceptually, the absence of a positive quality may be quite different from, and have different effects than, the presence of a negative quality (Higgins, 1999). Also, peoples' construals of the word *satisfaction* might differ substantially when they consider dissatisfaction rather than satisfaction. Thus, to find that the same candidate needs emerge as important within both approaches would lend additional support for those candidacies.

### Method

#### Participants and Procedure

Participants were 233 students in a psychology course at the University of Missouri who participated in the research for extra credit points. The measures were contained within a single questionnaire packet, which was administered in a group session near the end of the semester. Participants first identified a "most satisfying event" and then rated it in terms of both affect and candidate needs, then they identified and rated a "most unsatisfying event."

#### Measures

**Most satisfying event.** Instructions for identifying a "most satisfying event" were identical to those in Studies 1 and 2, with one exception: All participants were asked to "consider the entire semester" as they identified a particularly salient event.

Participants rated the event in terms of the same 30 descriptive statements used in Studies 1 and 2, using the same stem: "During this event I felt..." Need-satisfaction scores were computed for each of the 10 candidate needs by averaging the three relevant items. Participants also rated the extent to which they felt the 20 PANAS moods during the event, using a scale of 1 (*not at all*) to 5 (*very much*). Positive and negative affect scores were computed by averaging the appropriate ratings, and an affect-balance variable was computed by subtracting the score for negative affect from the score for positive affect.

To illustrate what types of events were designated as the "most satisfying of the semester," we identified the events with the highest associated affect-balance scores. Two events within the sample emerged by this criterion, namely "Going on a retreat with my friends at church. We did a service event and cleaned up a summer camp," and "When I got the summer job of my dreams." (both events reported verbatim).

**Most unsatisfying event.** Participants were next asked the following:

bring to mind the single most *unsatisfying* event that you experienced in the entire semester. That is, what is the least rewarding thing that happened to you during winter semester, 2000? Please think of unsatisfying in whatever way makes sense to you.

After writing their description, participants were asked "What was missing from this event, that is, why was it unsatisfying?" The same 30 descriptive statements were used that were used in Studies 1 and 2, with the wording altered so that they became negatives. For example, "During the event I felt that my choices were based on my true interests and values" became "During the event I felt that my choices were not based on my true interests and values." The stem "this event was unsatisfying because..." prefaced all items, and a scale of 1 (*not at all the reason*) to 5 (*very much the reason*) was given. Need-deficiency scores were later computed for each of the 10 candidate needs by averaging the three relevant items. Participants also rated the extent to which they felt the 20 PANAS moods during the event, using a scale of 1 (*not at all*) to 5 (*very much*). Positive and negative affect scores were computed by averaging the appropriate ratings, and an affect-



balance variable was computed by subtracting the score for the negative affect from the score for positive affect.

To illustrate what types of events were designated as the "least satisfying of the semester," we identified the events with the lowest associated affect-balance scores. Two events emerged by this criterion, namely "Broke up with a girlfriend of 2 years, 8 months." and "Getting jumped by 10 Mexicans while on spring break in Cancun."

### Results

#### Most Satisfying Event of the Semester

*Mean differences in the salience of candidate needs.* Table 6 presents the mean salience of the 10 candidate needs within participants' "most satisfying event of the semester." These data essentially replicate the earlier results, for this longer time frame. As in Study 2, self-esteem was the most salient characteristic, and autonomy, competence, and relatedness were again in a three-way tie in the second position. Pleasure-stimulation and self-actualization-meaning occupied the third position. Security, popularity-influence, and physical thriving occupied the fourth position, and once again, money-luxury was last on the list.

*Associations of need satisfaction with event-related affect.* Table 7 contains the correlations of each of the candidate needs with event-related positive affect, negative affect, and affect balance. As can be seen, all 10 needs correlated positively with positive affect, whereas only some of the needs were significantly related to low negative affect. All 10 needs were significantly associated with aggregate affect balance.

*Regression comparisons.* We next conducted regression comparisons, as in Studies 1 and 2, to test for unique variances. First, positive affect was regressed simultaneously on autonomy, competence, and relatedness. All three predictors were significant at the .01 level ( $\beta$ s = .23, .41, and .27, respectively). Next, negative affect was regressed on these three variables. Only autonomy was significant ( $\beta$  = -.16,  $p$  < .05). Finally, affect balance was regressed on autonomy, competence, and relatedness. All three

predictors supplied significant variance ( $\beta$ s = .25, .16, and .23, respectively; all  $ps \leq .01$ ). We then entered the remaining seven needs. In this most stringent analysis, autonomy was significant and relatedness was marginally significant ( $\beta$ s = .17 and .12), whereas competence was not significant ( $\beta$  = .00). Self-esteem ( $\beta$  = .38,  $p$  < .01) and money-luxury ( $\beta$  = -.14,  $p$  < .05) were also significant in this analysis.

#### Most Unsatisfying Event of the Semester

*Mean differences in need deprivation scores.* Table 6 also presents the mean ratings for each of the 10 candidate needs within the "most unsatisfying" event. Again, we construe these as deprivation scores, because they represent participants' views of what was missing in the unsatisfying experience. As can be seen, the primary reason why the listed events were unsatisfying, according to these ratings, was that experiences of competence were missing. In addition, the other two needs specified by self-determination theory, autonomy and relatedness, were also rated as strongly lacking within unsatisfying experiences. Finally, self-esteem was also rated as strongly absent. In short, this clustering of means is quite consistent with our hypotheses and with earlier findings. However, one interesting difference from earlier studies did emerge: A fifth candidate need, security, was also perceived as strongly lacking within the unsatisfying events. Finally, lack of pleasure-stimulation, popularity-influence, self-actualization-meaning, and physical thriving were deemed to be less responsible for the event's unsatisfying nature, and lack of money-luxury was deemed to be least responsible.

*Associations of need deprivation with event-related affect.* Table 7 presents the correlations between deprivation scores and event-related affect. As can be seen, only competence and self-esteem, in their absence, were associated with low positive affect. The general lack of associations between dissatisfaction and positive affect parallels the earlier studies, in which few associations were found between satisfaction and negative affect.

In contrast, all 10 of the deprivation scores were correlated with event-related negative affect. The correlation between missing security and event-related negative affect was of the greatest magnitude ( $r$  = .50,  $p$  < .01), followed by missing relatedness and missing self-actualization-meaning ( $r$ s = .39 and .35, respectively). All but two of the candidates, popularity-influence and money-luxury, were associated with the compound affect-balance variable. That is, when participants perceived autonomy, competence, relatedness, self-esteem, pleasure-stimulation, physical thriving, self-actualization-meaning, or security as strongly missing within an unsatisfying event, they also reported a higher predominance of negative compared with positive affect within that event.

*Regression comparisons.* As in the other studies, positive affect was first regressed on autonomy, competence, and relatedness. Only missing competence was significant in this analysis ( $\beta$  = -.20,  $p$  < .01). Next, negative affect was regressed on these three variables. Once again, only competence was significant ( $\beta$  = .24,  $p$  < .01). Finally, and most importantly, the affect-balance variable was regressed on autonomy, competence, and relatedness. Competence was significant in this analysis ( $\beta$  = -.30,  $p$  < .01), and relatedness was marginally significant ( $\beta$  = -.11); autonomy was nonsignificant. We then entered the remaining seven needs into the

Table 6  
Study 3: Mean Salience of Each Candidate Need Within  
Participants' Most Satisfying and Most Unsatisfying  
Experiences of the Semester

Candidate need	Presence within the most satisfying event		Absence within the most unsatisfying event	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Self-esteem	3.97 <sub>a</sub>	1.00	2.66 <sub>b</sub>	1.27
Autonomy	3.77 <sub>b</sub>	1.01	2.86 <sub>b</sub>	1.11
Competence	3.73 <sub>b</sub>	1.15	3.02 <sub>a</sub>	1.23
Relatedness	3.66 <sub>b</sub>	1.31	2.63 <sub>b</sub>	1.32
Pleasure-stimulation	3.38 <sub>c</sub>	1.13	2.40 <sub>c</sub>	1.05
Self-actualization-meaning	3.24 <sub>c</sub>	1.23	2.63 <sub>b</sub>	1.15
Security	3.00 <sub>d</sub>	1.07	2.77 <sub>b</sub>	1.12
Popularity-influence	2.93 <sub>d</sub>	1.12	2.37 <sub>c</sub>	1.16
Physical thriving	2.91 <sub>d</sub>	1.24	2.34 <sub>c</sub>	1.23
Money-luxury	2.24 <sub>e</sub>	1.21	1.77 <sub>d</sub>	1.01

Note. Means within columns not sharing subscripts are significantly different from each other at  $p \leq .01$ .

Table 7

Study 3: Correlations of Candidate Needs With Event-Related Affect, Separately for Satisfying and Unsatisfying Events

Candidate need	Presence within the most satisfying event			Absence within the most unsatisfying event		
	Positive affect	Negative affect	Affect balance	Positive affect	Negative affect	Affect balance
Self-esteem	.57**	-.28**	.52**	-.13*	.39**	-.36**
Autonomy	.46**	-.18*	.39**	-.03	.19**	-.16**
Competence	.46**	.07	.22**	-.19*	.25**	-.31**
Relatedness	.33**	-.19**	.32**	-.05	.13*	-.13*
Pleasure-stimulation	.40**	-.14*	.33**	-.02	.14*	-.14*
Physical thriving	.36**	-.08	.27**	-.05	.23**	-.19**
Self-actualization-meaning	.32**	-.03	.21**	-.08	.35**	-.30**
Security	.33**	-.15*	.29**	-.02	.50**	-.37**
Popularity-influence	.43**	-.13*	.34**	.06	.23**	-.12
Money-luxury	.18**	-.03	.12	.10	.23**	-.10

\* $p < .05$ . \*\* $p < .01$ .

equation. In this most stringent analysis, only competence ( $\beta = -.22$ ,  $p < .01$ ), security ( $\beta = -.26$ ,  $p < .05$ ), and self-esteem ( $\beta = -.18$ ,  $p < .01$ ) were significant. Thus, it appears that the absence of competence, self-esteem, and security within an unsatisfying event has the greatest impact on the low-positive and high-negative affect associated with that event.

### Discussion

In the first part of Study 3, the basic pattern of findings from Studies 1 and 2 was replicated for a longer time frame. Specifically, self-determination theory's three proposed needs again emerged as important determinants of satisfaction by the "salience" criterion. In addition, all three emerged as important by the "affect" criterion (although competence became nonsignificant in the most stringent simultaneous analysis). Furthermore, self-esteem again emerged as very important by both criteria. These findings help to enhance confidence in the earlier results and also help establish that the sources of satisfaction tend to be the same across different temporal frames.

Study 3 also provided preliminary evidence regarding the important issue of deprivation. Again, it is possible to view psychological needs as qualities whose absence leads to unhappiness and even "deficiency" diseases, as well as qualities whose presence leads to happiness and growth (Maslow, 1954). Because deficiency needs and enhancement needs do not necessarily overlap, to find that the same candidate needs emerge as important by both criteria would strengthen the case for those needs. In this light, the results of Study 3 offered somewhat mixed support for our primary hypotheses. Autonomy, competence, and relatedness again emerged as very important needs by the "salience" criterion (i.e., participants perceived them as strongly missing within unsatisfying events). Furthermore, the absence of all three of the needs specified by self-determination theory was correlated with event-related negative affect. However, the simultaneous analyses revealed that only the absence of competence carried unique predictive variance with respect to event-related affect, indicating that missing autonomy and missing relatedness may be less important determinants of felt dissatisfaction. Once again, self-esteem

emerged as important by both criteria. Finally, security emerged for the first time as a potentially important need, specifically, in association with "most unsatisfying" events.

### General Discussion

#### Summarizing the Results

What are the fundamental psychological needs? The results of these three studies nicely support our new method for addressing this important question. First, we found relatively consistent results across our two criteria for determining needs. This is important because it lends greater confidence to our conclusions, and it also suggests that participants are aware of "what's satisfying about satisfying events." Second, we found largely consistent results across three different time frames (i.e., the most satisfying event of the last week, of the last month, and of the entire semester). This is important because it indicates that our results are not artifacts of the particular time frame addressed. Third, although our results were generally consistent across two different cultures, there were also meaningful and interpretable differences. This is important because it suggests that our measurement approach is able to detect effects consistent with other findings in the literature. Finally, the method yielded results quite consistent with theory, in particular Deci and Ryan's (1985, in press) self-determination theory but also with the many theories that posit self-esteem as a fundamental human need (Epstein, 1990; Greenberg et al., 1995; Leary, 1999). This consistency is important because it suggests that our new approach may supply a fruitful new means of confirming and perhaps extending existing theories of optimal experience.

Specifically, the results lend good support for self-determination theory's proposal that autonomy, competence, and relatedness are basic psychological needs (Deci & Ryan, in press). These three qualities of experience emerged among the four most salient in every sample, and they accounted for independent variance in the affect associated with satisfying events. Accordingly, they better met our two criteria for identifying needs than did six other candidates, including pleasure-stimulation, physical thriving, self-

actualization—meaning, security, popularity—influence, and money—luxury. Thus, it appears that self-determination theory's "big three" needs of autonomy, competence, and relatedness may indeed serve as important foundations on which to build a unified typology of motives, in the same way that the Big Five personality traits have served to unify trait psychology (McCrae & Costa, 1995). In addition to confirming important postulates of self-determination theory, the current research also extends past self-determination theory research in three major ways: by testing autonomy, competence, and relatedness against seven other theoretically derived needs, by introducing a new narrative methodology for studying needs, and by introducing a new criterion for identifying "true" needs.

It is interesting that if one were to pick a single need that is most important to satisfy in the United States, the current data suggest it would be self-esteem. Not only was self-esteem at the top of the list in all three U.S. samples, it also accounted for the most independent variation in event-related affect. Self-determination theory does not have a way to account for these findings, except perhaps to consider self-esteem as a well-being outcome rather than as a predictor. However, given the prominence of self-esteem in so many other need-based theories, it might be imprudent to consign self-esteem to the outcome category rather than considering it as a need in its own right. Another way for self-determination theory to account for these results would be to consider self-esteem as a broader manifestation of the competence need. However, even though they may ultimately share roots, competence and self-esteem were empirically separable in our research. Accordingly, our results concerning "most satisfying events" suggest the preliminary conclusion that there may be four fundamental psychological needs, not three: autonomy, competence, relatedness, and self-esteem.

In support of this idea is that self-esteem, autonomy, competence, and relatedness also ranked at the top within the South Korean sample, just as in the U.S. samples. As mentioned earlier, the appearance of autonomy within this group is important because it supports Deci and Ryan's claim that autonomy is a universal need (Deci & Ryan, in press), a claim that has been recently questioned (Markus et al., 1996). Notably, however, in South Korea the single most important need to satisfy appears to be relatedness. Given the collectivistic and communal orientation that characterizes Korean culture, this finding makes intuitive sense (Choi & Choi, 1994; Diener, Suh, Smith, & Shao, 1995; Kim, 1994). Although some might feel that this finding poses a challenge to our theory, we would again stress that our approach only specified a set of important needs, and it made no predictions regarding relative orderings within this set. Thus, in sum, it appears that both universalist and cross-culturalist perspectives concerning fundamental psychological needs may be correct, in different ways. That is, although all humans may need certain basic experiences to be happy, it appears that different cultures may emphasize or condone some experiences more than others, leading to meaningful variations within the basic set. Of course, the cross-cultural findings remain to be replicated, ideally in other collectivist cultures besides South Korea.

Study 3 replicated the Study 1 and Study 2 effects concerning "what's satisfying about satisfying events," and it also supplied interesting preliminary information about "what's unsatisfying about unsatisfying events." The lack of autonomy, competence, and relatedness emerged as most salient within participants' direct

ratings of their most unsatisfying events, echoing the earlier findings concerning satisfying events and further supporting self-determination theory's assumption that these are fundamental needs. Again, self-esteem was also important by this criterion. Of interest is that lack of security also emerged as a fifth prominent feature of unsatisfying events, consistent with deficiency-based models of needs (Maslow, 1954). It appears that when things go wrong, people may strongly wish for the safety and predictability that they often take for granted.

One other finding is notable: Results appear to be robust with respect to relevant individual differences. In Study 1, variations in individual need-preferences did not moderate the main effects of need experiences on event-related affect, as would be expected by a "matching" hypothesis in which experiences are especially satisfying if they accord with a person's preferences (Oishi, Diener, Suh, & Lucas, 1999). Additionally, in Study 2 there were no interactions of needs with culture (U.S. vs. Korean) in predicting event-related affect. In sum, then, we found good support for our universalist assumptions regarding the importance of autonomy, competence, and relatedness (Deci & Ryan, in press).<sup>4</sup>

What do we mean by "universal" needs? Although space precludes thorough consideration of this question, we will at least state our assumptions. Psychological needs are evolved desires that can be found within every member of the human species (Deci & Ryan, in press). These inborn yearnings carry little information about exactly what behaviors to engage in, a fact that allows for considerable behavioral plasticity. Instead, the needs tend to pull people toward the same general experiences and incentives within almost any behavioral domain. When a person behaves successfully within a particular life domain, then beneficial adaptive consequences and rewarding experiences ensue. These experiences help reinforce the particular behavior, causing the individual to seek further challenges and satisfactions within that domain. Thus, we suggest that psychological needs evolved, in part, to help individuals find conducive social and vocational niches and to motivate them to develop their skills further within those niches (Buss, 1997; Sheldon, in press). These speculations also await further research.

### *Rethinking the Hierarchy Concept*

Maslow's (1954) five-level hierarchical conception of needs has received little research support, although it remains popular in introductory-psychology textbooks. The current results suggest at least two fruitful ways of thinking about the need-hierarchy concept. One way to define a hierarchy is in terms of a prioritization of the relative importance of different elements. In such an approach, one may ask, "Which needs head the list, in terms of their strong salience to participants, and their demonstrated impact upon health and thriving outcomes?" Viewed in this way, our results suggest that autonomy, relatedness, competence, and self-esteem should be placed at the "top" of the hierarchy (although, again, the relative ordering of these four needs may vary from culture to

<sup>4</sup> Of course, it is difficult to draw conclusions from null effects. It may be that further studies, using different or better measures of individual differences in need preferences, would find more support for the matching hypothesis.

culture). Security, self-actualization—meaning, and physical thriving occupy a position of lower importance within the hierarchy. Finally, popularity—influence and money—luxury are of little or no importance, and money—luxury experiences may even be detrimental to satisfaction, at least considered relative to the other needs.

Notably, in such a “list”-based conception of hierarchy, there is no assumption that satisfaction of any particular need is a precondition for the satisfaction of any other need. However, one reason for the perennial appeal of Maslow’s theory is that it acknowledges a seemingly obvious truism: that it is easier to focus on the “finer” things if certain basics are taken care of (Oishi, Diener, Lucas, & Suh, 1999). In fact, although the complex five-level hierarchy proposed by Maslow has not withstood the test of time, there has been some support for a two-level distinction between “deficiency” or “security” needs on the one hand and “enhancement” or “growth” needs on the other (Wahbah & Bridwell, 1976). Our results may offer further support for such a distinction. First, in Study 3 a somewhat different pattern of findings was found regarding participants’ most unsatisfying (deficient) experiences compared with their most satisfying (enhancing) experiences. Specifically, insecurity emerged as very salient within participants’ “most unsatisfying” events and as a strong predictor of affect within such events. This is consistent with Maslow’s assumption that security needs must be taken care of before growth and positive experience can become predominant (see also Oishi, Diener, Lucas, & Suh, 1999). In addition, autonomy and relatedness did not as strongly influence the affect associated with unsatisfying events, suggesting that these two qualities of experience may be more important for obtaining enhancement than for avoiding deficiencies.

Thus, we suggest that one possible way to interpret the current results is to say that autonomy and relatedness needs occupy the higher, “enhancement” level of a two-tier hierarchy, whereas security occupies the lower “deficiency” level, and self-esteem and competence exist and have influence at both levels. Such an arrangement would explain why autonomy and relatedness were relatively less important within unsatisfying events, why security was relatively more important within unsatisfying events, and why self-esteem and competence were important for both types of events. This model would also take into account the fact that self-esteem can be either “contingent” or “true” (Deci & Ryan, 1995; Kernis, Brown, & Brody, 2000), that is, a source of anxiety or of genuine satisfaction, and also the fact that competence behaviors can be either appetitive or aversive (Elliot & Church, 1997; Elliot & Sheldon, 1997), that is, guided by extrinsic pressures or by intrinsic interests (Ryan & Deci, 2000). However, further research will be necessary to validate this preliminary suggestion and also to explore whether there is any contingent relationship between “lower”-level need-satisfaction and the subsequent satisfaction of “higher-level” needs.

#### *Limitations and Future Directions*

One potential limitation of the current research is that rare-but-powerful experiences, such as moments of spiritual conversion or personal transformation, are probably underrepresented by using the current methodology (Emmons, 1999): thus asking about “the most satisfying event of your whole life” might yield important

information. Relatedly, the typical frequency or category breadth of different types of experiences should be examined as additional predictive variables (e.g., winning the lottery, a low-frequency event, might for that reason be more satisfying than a hug from one’s spouse). A second limitation is our reliance on self-reported outcome variables. It would be desirable to show that need satisfaction is associated with other more objective indicators of thriving, such as physical health and successful task performance. Perhaps psychological needs will prove to be less important for such outcomes, compared with their effects on mood. Another limitation is our exclusive use of college-age individuals; perhaps older adults would find different kinds of experiences most satisfying, such as self-actualization—meaning or security. Additionally, our participants were relatively affluent and high-functioning; perhaps different candidate needs, such as money—luxury or popularity—influence, would emerge as most satisfying in stressed or impoverished populations (Biswas-Diener & Diener, 2000), if for no other reason than that they help individuals obtain the basic requirements of living. Also, it will be necessary to examine the effects of cultural variables and media on construals of satisfaction; perhaps the very concept of satisfaction is inextricably tied to western-style psychological needs (Markus et al., 1996). Finally, it will be important to replicate the current findings using other question wordings (Schwarz & Strack, 1999), and also with other methodologies besides “most satisfying event” descriptions, such as daily diary, experience sampling, or ethnographic approaches. In addition, other candidate needs beyond our 10 might be examined, such as needs for cognition, closure, or self-consistency.

#### *Conclusion*

What’s satisfying about satisfying events? In other words, what experiential contents and characteristics make people happiest, and thus qualify as psychological needs? According to the current research, the answer is autonomy, competence, relatedness, and self-esteem. Security may also be a need, which becomes salient in times of privation. Pleasure—stimulation, self-actualization—meaning, popularity—influence, and physical thriving are less important, and we would tend to deny them “need” status. Least deserving of need status is money—luxury. Although further work is required, we suggest that these findings may have strong relevance for society’s goal of providing optimal social and developmental environments for its citizens (Kahneman, Diener & Schwarz, 1999). In other words, it appears that authorities and social planners should try to help their charges obtain regular experiences of autonomy, competence, relatedness, and self-esteem in order to ensure that they thrive.

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## Appendix

### Labels and Conceptual Definitions of Needs Used in the Measure of Individual Differences in Need Preferences in Study 1

1. *Autonomy-independence*: Feeling like you are the cause of your own actions rather than feeling that external forces or pressures are the cause of your actions.
2. *Competence-effortance*: Feeling that you are very capable and effective in your actions rather than feeling incompetent or ineffective.
3. *Relatedness-belongingness*: Feeling that you have regular intimate contact with people who care about you rather than feeling lonely and uncared for.
4. *Self-actualization-meaning*: Feeling that you are developing your best potentials and making life meaningful rather than feeling stagnant and that life does not have much meaning.
5. *Security-control*: Feeling safe and in control of your life rather than feeling uncertain and threatened by your circumstances.
6. *Money-luxury*: Feeling that you have plenty of money to buy most of what you want rather than feeling like a poor person who has no nice possessions.
7. *Influence-popularity*: Feeling that you are liked, respected, and have influence over others rather than feeling like a person whose advice or opinions nobody is interested in.
8. *Physical-bodily*: Feeling that your body is healthy and well-taken care of rather than feeling out of shape or unhealthy.
9. *Self-esteem-self-respect*: Feeling that you are a worthy person who is as good as anyone else rather than feeling like a "loser."
10. *Pleasure-stimulation*: Feeling that you get plenty of enjoyment and pleasure rather than feeling bored and understimulated by life.

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## Research Article

A CROSS-CULTURAL ANALYSIS OF AVOIDANCE  
(RELATIVE TO APPROACH) PERSONAL GOALSAndrew J. Elliot,<sup>1</sup> Valary I. Chirkov,<sup>1</sup> Youngmee Kim,<sup>1</sup> and Kennon M. Sheldon<sup>2</sup><sup>1</sup>University of Rochester and <sup>2</sup>University of Missouri-Columbia

**Abstract**—*The results from this research supported our primary hypothesis that the adoption of avoidance (relative to approach) personal goals varies as a function of individualism-collectivism (across representations of this distinction). Interdependent self-construals were positively related and independent self-construals were negatively related to adoption of avoidance goals (Study 1), Asian Americans adopted more avoidance goals than non-Asian Americans (Study 2), and persons from South Korea and Russia adopted more avoidance goals than those in the United States (Studies 3 and 4, respectively). Studies 3 and 4 investigated and found support for our secondary hypothesis that avoidance personal goals are a negative predictor of subjective well-being in individualistic (the United States), but not collectivistic (South Korea and Russia), countries. The findings are discussed in terms of other approach-avoidance constructs and motivational processes.*

The distinction between approach and avoidance motivation is fundamental and basic to the study of human behavior. In approach motivation, behavior is instigated or directed by a positive event or possibility, whereas in avoidance motivation, behavior is instigated or directed by a negative event or possibility (Elliot, 1999). This approach-avoidance distinction is applicable to several different levels of conceptual analysis, from global motives to goals to rudimentary reflexes, and has been shown to have theoretical and empirical utility in numerous research domains throughout the history of scientific psychology.

One important construct at the goal level of analysis is that of personal goals, which represent the consciously articulated, personally meaningful objectives that individuals pursue in their daily lives (Emmons, 1986; B. Little, 1983). With regard to personal goals, the approach-avoidance distinction is based on the focus of the goal. Approach goals are focused on a positive outcome or state, and regulation involves trying to move toward or maintain that outcome or state (e.g., "do well in school," "make friends"); avoidance goals are focused on a negative outcome or state, and regulation involves trying to move or stay away from that outcome or state (e.g., "not do poorly in school," "avoid losing friends").

To date, empirical investigation of avoidance (relative to approach) personal goals has taken place entirely within Western countries, and nearly exclusively in the United States. In the present research, we sought to investigate avoidance personal goals in cross-cultural context by utilizing the individualism-collectivism distinction<sup>1</sup> at the levels of cultural attribute (i.e., country), ethnic category, and psychological construal (see Brockner & Chen, 1996). As idiographic representa-

tions of self and identity, personal goals seem ideal for investigating cross-cultural differences in approach-avoidance motivation. Two objectives guided our research. Our primary objective was to investigate whether the adoption of avoidance personal goals varies as a function of individualism-collectivism. Our secondary objective was to investigate whether the relationship between avoidance personal goals and subjective well-being (SWB) varies as a function of individualism-collectivism.

Culture plays an integral, formative role in the development of the individual's cognitive, affective, and motivational processes. Through socialization, persons are provided with an interpretive framework that establishes their view of the world, the self, and the self's place in the world (Markus, Kitayama, & Heiman, 1996; Shweder et al., 1998). In individualistic cultures, the self is construed in independent terms as a separate, distinct entity, and the main task of the person is to "stand out" by becoming distinguished from others through self-sufficiency and personal accomplishment. In collectivistic cultures, the self is construed in interdependent terms as a connected, relational entity, and the main task of the person is to "fit in" by maintaining interpersonal relationships and group harmony (Heine & Lehman, 1999; Markus & Kitayama, 1991). These different cultural perspectives are presumed to promote different motivational processes. The individualistic emphasis on standing out fosters a bias toward positive information and a focus on acquiring positive characteristics that establish or affirm one's distinctiveness; conversely, the collectivistic emphasis on fitting in fosters a bias toward negative information and a focus on eliminating negative characteristics that helps one avoid relational discord or group disruption (Heine, Lehman, Markus, & Kitayama, 1999; Markus et al., 1996).

In short, individualistic and collectivistic cultures appear to differentially promote approach and avoidance motivational processes, respectively. The extant research seems consistent with this characterization. Cross-cultural comparisons have revealed that collectivism, relative to individualism (whether operationalized in terms of cultural attribute, ethnic category, or psychological construal), is associated with more pessimism, higher fear of academic failure, a greater attentiveness to negative self-relevant information, a preference for loss-framed information, a valuing of shame tactics in child rearing, and a tendency toward self-criticism (see Heine et al., 1999; Lee, Aaker, & Gardner, 2000, for reviews). In the present research, our primary hypothesis was that persons with interdependent self-construals (Study 1), Americans of Asian descent (Study 2), and persons in collectivistic countries (Studies 3 and 4) would adopt more avoidance personal goals in negotiating their daily lives than persons with independent self-construals, Americans of non-Asian descent, and persons in individualistic countries, respectively.

Research on the relationship between avoidance personal goals and SWB has demonstrated that avoidance goals are a negative predictor of SWB (Elliot & Church, in press; Elliot & Sheldon, 1997; Elliot, Sheldon, & Church, 1997). To date, all of this research has been conducted with U.S. samples. It is possible that this finding generalizes

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1. We use this distinction generically to represent a widely acknowledged set of differences in how persons define themselves in relation to others.



## Avoidance Personal Goals

across cultural contexts, but we suspect that it may be culturally constrained.

Most individuals, regardless of their culture, desire to feel that they are a valuable member of society (Heine & Lehman, 1999), and evaluate their SWB, at least in part, on this basis. Culture dictates what it means to be a valued societal participant, and optimal functioning in a given culture entails utilizing self-regulatory tactics (e.g., goals) that are attuned to and, therefore, effectively serve these cultural emphases (Kitayama, Markus, Matsumoto, & Norasakkunkit, 1997). Avoidance goals (i.e., regulating according to negative outcomes) seem ill-suited to the individualistic emphasis on standing out, which fosters a bias toward positive information and a desire for positive outcomes. Thus, it is not surprising that avoidance goals have evidenced a negative relationship with SWB in the United States. However, avoidance goals seem more concordant with the collectivistic emphasis on fitting in, which fosters a bias toward negative information and a desire to avoid negative outcomes. Therefore, avoidance goals may not be negatively associated with SWB in collectivistic cultures. In the present research, we investigated the relationship between avoidance personal goals and SWB in South Korea and the United States (Study 3) and Russia and the United States (Study 4). We hypothesized that avoidance goals would be negatively related to SWB in the U.S. samples (replicating prior work), but would not be negatively related to SWB in the South Korean sample nor the Russian sample.

## STUDY 1

In this study, we examined whether the adoption of avoidance personal goals varies as a function of psychological construal. We hypothesized that interdependent self-construals would be positively related, and independent self-construals negatively related, to adoption of avoidance personal goals.

## Method

Thirty-five male and 72 female U.S. undergraduates participated in the study; the sample was limited a priori to those of non-Asian descent. Participants completed the assessments in a take-home packet. Singelis's (1994) Self-Construal Scale was used to assess participants' interdependent ( $\alpha = .71$ ) and independent ( $\alpha = .73$ ) self-construals. Participants' personal goals were assessed using a revised version of Emmons's (1986) procedure for eliciting personal strivings (Elliot et al., 1997) in which individuals list the eight goals that they typically strive for in their daily life. Two trained coders independently categorized each goal as approach or avoidance; in this and all subsequent studies, interjudge agreement exceeded 99%, and coders were blind to

all other variables. An avoidance-goals index was created by summing the number of avoidance goals listed and dividing by the total number of goals (given that approach-avoidance was coded dichotomously for each goal, approach and avoidance were reciprocal, and this measure functionally represents avoidance relative to approach goals). Participants reported their sex after completing the other measures.

## Results and Discussion

In this and all subsequent studies, preliminary analyses were conducted to control for the main and interactive effects of sex and, in Studies 3 and 4, other important control variables. These control variables were retained in the final analyses when significant (see Judd & Kenny, 1981); all significant results are reported.

The intercorrelations among the Study 1 variables are presented in Table 1. Consistent with our predictions, Pearson product-moment correlations revealed that interdependent self-construals were a positive predictor of avoidance goals,  $r = .23, p < .05$ , and independent self-construals were a negative predictor,  $r = -.20, p < .05$ . A multiple regression analysis testing both self-construals simultaneously yielded the same results: Interdependent self-construals were a positive predictor of avoidance goals,  $\beta = .23, p < .05$ , and independent self-construals were a negative predictor,  $\beta = -.24, p < .05$ .

## STUDY 2

In this study, we sought to replicate Study 1 using ethnic category rather than psychological construal to represent the individualism-collectivism distinction.

## Method

Sixty-five male and 116 female U.S. undergraduates participated in the study. Participants reported their sex and ethnicity at the beginning of the study, and approximately 1 week later attended a group session to complete the personal-goals assessment. The personal-goals assessment and avoidance-goal measure were the same as in Study 1, except that participants listed the goals that they would be pursuing during the next 3 months at minimum.

## Results and Discussion

The intercorrelations among the Study 2 variables are presented in Table 2. Two contrasts were created for the analyses: Asian Americans ( $n = 22$ ) versus non-Asian Americans ( $n = 159$ ) and Asian Americans versus Caucasian Americans specifically ( $n = 137$ ). Consistent with

**Table 1.** Intercorrelations among variables in Study 1

Variable	Avoidance goals	Interdependent self-construals	Independent self-construals	Sex
Avoidance goals	—			
Interdependent self-construals	.23*	—		
Independent self-construals	-.20*	.03	—	
Sex	-.03	.00	.19	—

\* $p < .05$ .



**Table 2.** Intercorrelations among variables in Study 2

Variable	Avoidance goals	Asian Americans vs. non-Asian Americans	Asian Americans vs. Caucasian Americans	Sex
Avoidance goals	—			
Asian Americans vs. non-Asian Americans	.17*	—		
Asian Americans vs. Caucasian Americans	.17*	—	—	
Sex	.12	.07	.07	—

\* $p < .05$ .

our predictions,  $t$  tests revealed that Asian Americans ( $M = .24$ ) listed more avoidance goals than did non-Asian Americans ( $M = .17$ ),  $t(179) = 2.31$ ,  $p < .05$ , and Caucasian Americans specifically ( $M = .17$ ),  $t(157) = 2.10$ ,  $p < .05$ .

### STUDY 3

In this study, we sought to replicate Studies 1 and 2 using country (United States vs. South Korea) to represent the individualism-collectivism distinction. In addition, we examined the relationship between avoidance personal goals and SWB in the two countries. We hypothesized that avoidance goals would be negatively related to SWB in the U.S. sample, but would not be negatively related to SWB in the South Korean sample.

#### Method

Two hundred ninety-two undergraduates participated in the study: 42 males and 60 females from the United States, and 118 males and 72 females from South Korea.<sup>2</sup> Care was taken to maximize the comparability of the two samples; for example, participants from both countries were introductory psychology students at research-oriented universities of similar size (more than 15,000 students).

All instructions and measures were translated from English to Korean by a Korean psychologist, and back-translated by a second Korean individual proficient in English and Korean. Independent judges in the United States assessed the equivalence of the original and back-translated versions of the measures and made minor revisions to the measures accordingly.

Participants attended a small-group session in which their personal goals and SWB were assessed, and demographic information was obtained. The personal-goals assessment and the avoidance-goals measure were the same as in Study 1, except that Emmons's (1986) original procedure for eliciting personal strivings was utilized. SWB was assessed using affect-balance (Positive Affect/Negative Affect Scale; Watson, Tellegen, & Clark, 1988) and life-satisfaction (Satisfaction With Life Scale; Diener, Emmons, Larsen, & Griffin, 1985) measures; the SWB index was created by summing the standardized scores from the individual measures (item level  $\alpha = .89$ ). Information regarding participants' sex, marital status, parental education, and family in-

come was also obtained; each of these variables has been identified as an important control variable in SWB research (see Diener, Suh, Lucas, & Smith, 1999). Participants reported their mother's and father's highest level of education (on a scale from "less than high school" [1] to "beyond college" [6]), and these two scores were summed to form the parental-education index. Participants reported their family's yearly income on a 9-point scale with monetary values calibrated across the two countries.

#### Results and Discussion<sup>3</sup>

The intercorrelations among the Study 3 variables are presented in Table 3.

##### Country as a predictor of avoidance goals

Consistent with our prediction, a  $t$  test revealed that South Korean participants listed more avoidance goals ( $M = .11$ ) than did U.S. participants ( $M = .08$ ),  $t(290) = 2.32$ ,  $p < .05$ .

##### Preliminary SWB analyses

Mean and covariance structures (MACS) analysis was used to assess the measurement equivalence of SWB across the two countries (T. Little, 1997), with both the factor loadings and the intercepts of the indicators constrained to be equal across groups. The root mean squared error of approximation (RMSEA), nonnormed fit index (NNFI), and incremental fit index (IFI) were used to assess the fit of the model to the data (T. Little, 1997). This analysis supported the measurement equivalence of SWB in the United States and South Korea:  $RMSEA = .052$ ,  $NNFI = .99$ ,  $IFI = .98$ . Thus, it was possible to proceed with confidence that the cross-cultural comparisons were being conducted with a comparable SWB construct.

An analysis of covariance revealed that U.S. participants reported higher SWB (adjusted  $M = 1.18$ ) than did South Korean participants (adjusted  $M = -0.68$ ),  $t(289) = 9.49$ ,  $p < .05$ ; males reported higher

2. Two participants completed the goal assessment twice (listing different sets of goals); these participants were excluded from the analyses.

3. Following an anonymous reviewer's suggestion, in this study and the next we had two coders independently categorize each goal for achievement and affiliation content using Emmons's (1999) coding system (interjudge agreement exceeded 95%), and we repeated all analyses controlling for these goal contents (both independently and jointly). In both studies, all results reported in the text remained the same in these reanalyses.

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**Table 3.** Intercorrelations among variables in Study 3

Variable	Avoidance goals	Country	Subjective well-being	Sex	Married	Parental education	Family income
Avoidance goals	—						
Country	.14*	—					
Subjective well-being	-.16**	-.47**	—				
Sex	.08	-.20**	-.02	—			
Married	.04	.04	-.02	-.03	—		
Parental education	.01	-.40**	.14*	.04	-.02	—	
Family income	.01	.00	.08	.02	.00	.34**	—

\* $p < .05$ . \*\* $p < .01$ .

SWB (adjusted  $M = 0.19$ ) than did females (adjusted  $M = -0.23$ ),  $t(289) = 2.20$ ,  $p < .05$ . This between-country finding replicates prior research showing lower SWB in South Korean than U.S. samples (Diener & Diener, 1995).

#### Avoidance goals as a predictor of SWB

Consistent with prior research, a multiple regression analysis with U.S. participants revealed that avoidance goals were a negative predictor of SWB,  $F(1, 96) = 4.57$ ,  $p < .05$  ( $\beta = -.21$ ); as we predicted, however, this relationship did not even approach significance in the analysis with South Korean participants,  $F(1, 187) = 1.35$ ,  $p > .24$  ( $\beta = -.08$ ). In the U.S. analysis, the interactions of avoidance goals with parental education ( $\beta = -.26$ ,  $p < .01$ ) and marital status ( $\beta = -.25$ ,  $p < .01$ ) also attained significance (detailed information regarding interactive results may be obtained from the senior author); in the South Korean analysis, the family-education variable was also significant ( $\beta = .16$ ,  $p < .05$ ).

### STUDY 4

The majority of cross-cultural work contrasts one (or more) of the collectivistic countries of East Asia (e.g., China, Japan, South Korea) with the United States, and recently researchers have highlighted the need to attend to other collectivistic countries, such as those in Eastern Europe (Realo & Allik, 1999). Study 4 was an attempt to heed this call by examining whether the findings of Study 3 could be replicated with a Russian sample; Russia is characterized as a moderately collectivistic country in the cross-cultural literature (Ryan et al., 1999; Stetsenko, Little, Oettingen, & Baltes, 1995). We hypothesized that the Study 3 findings would indeed generalize to Russia.

#### Method

Two hundred sixty-three undergraduates participated in the study: 40 males and 59 females from the United States, and 72 males and 92 females from Russia.<sup>4</sup> As in Study 3, care was taken to maximize the comparability of the two samples; for example, participants from both countries were students at highly selective, research-oriented universities of similar size (fewer than 5,000 undergraduates).

4. A portion of the data in this study was also used by Ryan et al. (1999) to investigate a separate set of issues.

The procedure involved in translating the materials was comparable to that described for Study 3. In addition, the procedure and materials were the same as in Study 3, only participants listed 10 personal goals, a 5-point scale was used to assess maternal and paternal educational level, and a more extensive assessment of well-being was obtained for the SWB index (item level  $\alpha = .93$ ) by using measures of life satisfaction (Satisfaction With Life Scale; Diener et al., 1985), depression (Center for Epidemiological Studies Depression Scale; Radloff, 1977), vitality (Subjective Vitality Scale; Ryan & Frederick, 1997), self-actualization (Short Index of Self-Actualization; Jones & Crandall, 1986), and self-esteem (Rosenberg Self-Esteem Scale; Rosenberg, 1965).

#### Results and Discussion

The intercorrelations among the Study 4 variables are presented in Table 4.

#### Country as a predictor of avoidance goals

Consistent with our prediction, a  $t$  test revealed that Russian participants listed more avoidance goals ( $M = .16$ ) than did U.S. participants ( $M = .09$ ),  $t(261) = 4.62$ ,  $p < .01$ .

#### Preliminary SWB analyses

Results from a MACS analysis supported the measurement equivalence of SWB in the United States and Russia:  $RMSEA = .069$ ,  $NNFI = .90$ ,  $IFI = .92$ . A  $t$  test revealed that U.S. participants reported higher SWB ( $M = 1.20$ ) than did Russian participants ( $M = -0.76$ ),  $t(261) = 4.19$ ,  $p < .01$ , a finding consistent with prior research (Balatsky & Diener, 1993).

#### Avoidance goals as a predictor of SWB

Consistent with prior research, a Pearson correlation revealed that avoidance goals were a negative predictor of SWB for U.S. participants,  $r = -.36$ ,  $p < .01$ ; as we predicted, this relationship did not even approach significance for Russian participants,  $r = -.05$ ,  $p > .56$ .

### GENERAL DISCUSSION

The results from the present research supported our primary hypothesis that the adoption of avoidance (relative to approach) personal

Table 4. Intercorrelations among variables in Study 4

Variable	Avoidance goals	Country	Subjective well-being	Sex	Married	Parental education	Family income
Avoidance goals	—						
Country	.28**	—					
Subjective well-being	-.21**	-.25**	—				
Sex	.09	-.03	.00	—			
Married	-.04	.25**	-.02	.10	—		
Parental education	-.06	-.03	-.01	-.14*	.01	—	
Family income	.11	.01	.01	-.10	-.08	.36**	—

\* $p < .05$ . \*\* $p < .01$ .

goals varies as a function of individualism-collectivism. Interdependent self-construals were positively related and independent self-construals were negatively related to adoption of avoidance goals. Asian Americans adopted more avoidance goals than non-Asian Americans, and persons from collectivistic countries (South Korea and Russia) adopted more avoidance goals than those from an individualistic country (the United States). Thus, the proposition that collectivism, compared with individualism, promotes adoption of avoidance goals was documented across the three most common representations of individualism-collectivism utilized in the literature—psychological construct, ethnic category, and cultural attribute (i.e., country).

Although little empirical work has explicitly addressed the issue of cross-cultural differences in approach-avoidance motivation, as noted earlier, a few studies in the extant literature may be interpreted from an approach-avoidance standpoint. For example, research has found that collectivists, relative to individualists, are higher in neuroticism, lower in extraversion, higher in fear of failure, and higher in social anxiety, and use more avoidance-based coping strategies (Abe & Zane, 1990; Chang, 1996; Eaton & Dembo, 1997). The present findings complement this research by demonstrating that collectivists, relative to individualists, engage in more avoidance regulation at the goal level of analysis. Note that our research documented this approach-avoidance difference with an idiographic, rather than nomothetic, assessment procedure. Therefore, we were able to use participants' own personally articulated goal statements to demonstrate that collectivism promotes a greater emphasis on avoiding or eliminating the negative than does individualism.

Just as there has been little cross-cultural research conducted on approach-avoidance motivation, there has been a dearth of research conducted in any culture on antecedents of avoidance personal goals. The studies that have been conducted to date have focused on intrapsychic variables such as motive dispositions (Elliot & Sheldon, 1997) or neurophysiological sensitivities (Elliot & Sheldon, 1998; Elliot et al., 1997). The present research extends this work by documenting cultural context as an antecedent of avoidance personal goals. The findings discussed in the previous paragraph suggest that culture plays a role in the development of motive dispositions such as fear of failure and fear of rejection, and may even influence neurophysiological sensitivities such as neuroticism and extraversion (see also Markus et al., 1996). This raises the interesting possibility that these intrapsychic variables may, in part, account for (i.e., mediate) the link between individualism-collectivism and adoption of avoidance goals, and future work would do well to investigate this possibility.

In addition to supporting our primary hypothesis, the results of our studies provided support for our secondary hypothesis regarding the link between avoidance personal goals and SWB across cultures. Avoidance goals were a negative predictor of SWB in the United States, but were not a negative predictor of SWB in either South Korea or Russia.

In individualistic cultures such as the United States, the attainment of positive outcomes is emphasized and valued, whereas in collectivistic cultures such as South Korea and Russia, avoiding negative outcomes is emphasized and valued. Our results indicate that personal goals that mismatched the cultural emphasis (avoidance goals in the United States) were negative predictors of SWB, whereas those that matched the cultural emphasis (avoidance goals in South Korea and Russia) were not negative predictors of SWB. A conceptual parallel may be drawn between these results and those from Brunstein, Schultheiss, and Grassmann's (1998) recent research on goals and motives. These researchers demonstrated that personal goals are a negative predictor of SWB when they are incongruent with the individual's motive dispositions (e.g., agentic goals for a person high in the need for communion), but are not a negative predictor of SWB when they are congruent with the individual's motive dispositions (e.g., agentic goals for a person high in the need for agency). Our results document similar relationships, focusing on culture rather than motive dispositions, and goal valence rather than goal content.

Although avoidance personal goals were not negative predictors of SWB in South Korea and Russia, it is interesting to note that they were unrelated to SWB, rather than positively related. This may reflect a basic structural feature of avoidance goals—they enable one to acquire the absence of negative outcomes, but do not enable one to acquire the presence of positive outcomes (Elliot et al., 1997). It may be the case, across cultures, that the absence of negative outcomes (e.g., relational discord) can benefit SWB to some degree, in some situations, but that the presence of positive outcomes or "inputs" (e.g., relational harmony) is additionally required to optimally facilitate SWB (Ryan, 1995). Thus, in collectivistic countries, avoidance goals may not negatively predict SWB because they are in accord with the cultural emphasis on avoiding negative outcomes, but they may fail to positively predict SWB because they are unable to produce the positive outcomes needed by the organism. Alternatively, it is possible that the South Korean and Russian results simply reflect a limited assessment of SWB. The SWB measures that we used may be construed as emphasizing individual well-being, rather than relationship- or community-oriented well-being (e.g., collective self-esteem, relationship

## Avoidance Personal Goals

harmony or satisfaction), and these latter types of well-being may be what is most important to persons from collectivistic cultures and most relevant to their goal striving (Diener & Suh, 1999; Heine et al., 1999). Thus, avoidance goals might indeed facilitate SWB in collectivistic countries—but not the type of SWB that we examined. Clearly, additional research is needed to more intricately examine the complexities involved in the relationship between avoidance regulation and well-being across cultures.

Some limitations of the present research should be noted. First, as in all cross-cultural research (Singelis, 2000), the countries we contrasted in Studies 3 and 4 differ in many ways. For example, in addition to the individualism-collectivism dimension that we highlighted, the United States likely varies from South Korea and Russia on other cultural dimensions (e.g., the vertical-horizontal dimension; Triandis, 1995), and in terms of macrosocial characteristics (e.g., the nature and stability of their economic systems). Investigating whether the present findings can be replicated in other individualistic and collectivistic countries is an important priority. Second, the samples in our study were drawn from restricted segments of the U.S., South Korean, and Russian populations in order to maximize comparability. Accordingly, the generalizability of our findings to the populations at large remains an open question. Finally, the present research was correlational and concurrent in nature; therefore, definitive conclusions regarding causality are not warranted.

In sum, the present research adds to the expanding empirical corpus demonstrating the utility of the individualism-collectivism distinction in the analysis of psychological processes. In addition, our research highlights the importance of testing, rather than merely presuming, the invariance of empirical relationships across cultures (Fiske, Kitayama, Markus, & Nisbett, 1998). Our studies are among only a few cross-cultural investigations of goals that have been conducted in the literature to date, and we encourage other goal researchers, and motivational researchers more generally, to examine their constructs in cultural context. Such research is likely to be multiply beneficial, as it promises not only to yield information regarding cross-cultural differences, but also to further illuminate the precise nature of basic motivational processes.

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## Spirituality moderates the effect of stress on emotional and physical adjustment

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### Abstract

This study examined the relationship of spirituality with emotional and physical adjustment to daily stress. One hundred and thirteen college students completed questionnaire measures of spirituality, daily stress, affect, and physical symptoms at two times one month apart. The results showed that spirituality buffered the adverse effect of stress on adjustment, controlling for the use of various coping strategies. The findings have implications for developing prevention programs to improve people's coping skills by incorporating greater emphasis on spirituality. © 2001 Published by Elsevier Science Ltd. All rights reserved.

**Keywords:** Spirituality; Stress-buffering effect; Emotional and physical adjustment

The notion that religiousness or spirituality has beneficial health consequences has been supported by numerous empirical studies (see reviews by Joseph, 1998; Pargament, 1997). "Religiousness" and "spirituality" may be defined as overlapping concepts that involve "the subjective feelings, thoughts, and behaviors that arise from a search for the sacred" (Larson, Swyers, & McCullough, 1998, p. 22). They differ, however, in that religiousness also implies association with an identifiable group. Previous studies have focused on relations of religiousness with health, but due to the conceptual overlap between religiousness and spirituality, these studies also bear on the relation of spirituality with health.

Matthews, Larson, and Barry (1994), for example, reviewed research showing that religious factors were associated with lower substance use and negative affect, and with improved quality of life, life satisfaction, marital satisfaction, altruism, and self-esteem. In addition, religious

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1 factors were related to reduced blood pressure, improved general health, and longer life.  
2 However, not all studies supported the adaptive function of religiousness. For example,  
3 family members waiting for a relative undergoing coronary artery bypass surgery reported  
4 higher levels of depression and anxiety when they used religious coping strategies to  
5 adjust to the stress (Pargament, Cole, Vandecreek, Belavich, Brant, & Perez 1999). In  
6 diverse samples coping with assorted life stressors (i.e. people coping with the Oklahoma  
7 City bombing, college students coping with major life stressors, elderly hospitalized  
8 patients coping with serious medical illness, and church members coping with major life  
9 stressors), Pargament and colleagues identified positive and negative patterns of religious  
10 coping methods and found that the negative patterns (e.g. appraisals involving a punishing  
11 God, deferring to God's will) were associated with higher levels of distress and psychosomatic  
12 symptoms (Pargament, Smith, Koenig, & Perez, 1998; Pargament, Zinnbauer, Scott, Butter,  
13 Zerowin, & Stanik, 1998).

14 Although empirical studies consistently indicate that religiousness is commonly used in times of  
15 stress, they are inconsistent in showing its effectiveness. The discrepancy in the findings may result  
16 from using insensitive measures of religiosity, relying on cross-sectional designs, or failing to  
17 incorporate cultural diversity in measures and designs (Hathaway & Pargament, 1991; Thoresen,  
18 1999). It is also possible that the effectiveness of religiousness in coping depends on the level of  
19 stress experienced. Indeed, religiousness has been found to moderate the effect of stress on  
20 adjustment. Park and colleagues (Park, Cohen, & Herb, 1990) found that intrinsic religiousness  
21 moderated the effect of stress on depression for Protestant college students, although this mod-  
22 erating effect was not found for Catholics. This finding has been replicated with community  
23 adults (Hettler & Cohen, 1998) and patients and their significant others coping with kidney  
24 transplant surgery (Tix & Frazier, 1998).

25 The existing findings about religiousness suggest that the overlapping construct of spirituality  
26 may be a significant factor in mental and physical health, but it is still unclear how it is related to  
27 coping, and whether it influences health regardless of stressful circumstances or by moderating  
28 the effects of stress. We theorize that spirituality may buffer the effects of stress on health through  
29 its influence on four domains: cognition, emotion, behavior, and transcendence (Seidlitz, Aber-  
30 nethy, Duberstein, Evinger, Chang, & Lewis, 2000). Spiritual beliefs may boost self-esteem  
31 (Maltby, Lewis, & Day, 1999), or provide constructive attributional perspectives that help a per-  
32 son find his/her sense of meaning and purpose, thereby limiting mental health consequences of  
33 adverse life experiences (Clark, Friedman, & Martin, 1999; Koenig, Hays, George, Blazer, Lar-  
34 son, & Landerman, 1997; Spilka, Shaver, & Kirkpatrick, 1985). Spiritual involvement may reduce  
35 negative affect and increase feelings of security and comfort through fulfilled innate needs for  
36 relatedness (Cobb, 1976; House, Landis, & Umberson, 1988; Kobasa, Maddi, Puccetti, & Zola,  
37 1984; Sarason, Sarason, Potter, & Antoni, 1985; Wallston, Alagra, DeVellis, & DeVellis, 1983).  
38 Spiritual practices may limit the harmful effects of stress by developing supportive social net-  
39 works and promoting health behaviors (Koenig et al. 1997; Maltby et al., 1999; Waite, Hawks, &  
40 Gast, 1999). Finally, coping may be facilitated by the experience of transcending one's psycho-  
41 logical distress or physical suffering, giving a sense of secondary control over the situation (Par-  
42 gament et al., 1999; Seidlitz et al., 2000). These components of spirituality may contribute to  
43 mental or physical health above and beyond the effects of nonreligious coping strategies (Parga-  
44 ment, 1997; Pargament et al., 1999).

Previous studies have tended to focus on the effects of religiousness on adjustment in major stress situations such as illness (e.g. Koenig, Cohen, Blazer, Kudler, Krishnan, & Sibert, 1995; Oxman, Freeman, & Manheimer, 1995; Pargament, Smith et al., 1998; Tix & Frazier, 1998), victimization (Thompson & Vardaman, 1997), war (Pargament et al., 1994), and the death of a loved one (e.g. Hettler & Cohen, 1998; McIntosh, Silver, & Wortman, 1993; Park & Cohen, 1993). Spirituality, however, is a part of the everyday lives of most individuals (Pargament, 1997) and may also affect adjustment to minor daily life events. Because of the frequency of daily hassles, they may have a significant impact on health, even though they are less serious than major stressors (Bolger, DeLongis, Kessler, & Schilling, 1989; Eckenrode, 1984). Daily stressors often have been found to be significant correlates of physical symptoms (Cohen, Burt, & Bjork, 1987; Eckenrode, 1984; Holahan & Moos, 1991; O'Leary, 1990; Salovey, O'Leary, Stretton, Fishkin, & Drake, 1991). Indeed, a recent study showed that among individuals with pain due to rheumatoid arthritis, those who reported frequent daily spiritual experiences had higher levels of positive mood, lower levels of daily negative mood (Keefe et al., 2001). Therefore, the study of the role of spirituality in adjusting to daily stressors may have implications for health.

Whereas most studies on the impact of religiousness on adjustment have focused on elderly populations, several have examined its effects in college students. Some studies have found that religiosity in college students was positively associated with high self-esteem and problem-focused coping (Knox, Langehough, Walters, & Rowley, 1998; Maltby & Day, 1999; Maton, 1989) and negatively associated with depression, avoidance coping, substance use, or engaging in risky sexual behavior (Maltby & Day, 1999; Poulson, Eppler, Satterwhite, Wuensch, & Bass, 1998). However, other studies have found that religious coping was maladaptive (Pargament, Zinnbauer et al., 1998; Schafer, 1997) or unrelated to mental health (Bergin, Stinchfield, Gaskin, Masters, & Sullivan, 1988) or stress (Schafer & King, 1990). This research suggests that some types of religiousness may be adaptive whereas other types may be maladaptive. Findings may depend on how researchers define religiousness and which forms of religious coping they measure.

The purposes of the present study were: (1) to determine whether spirituality is related to better emotional and physical adjustment in college students; (2a) to examine whether spirituality buffers the effects of stress on emotional and physical adjustment over time; (2b) if spirituality buffers the adverse effects of stress, to examine whether these effects are the same regardless of affiliation with a religious group; and (3) to test the relative contributions of spirituality versus other coping strategies to emotional and physical adjustment.

## 1. Method

### 1.1. Participants

University students in Seoul, Korea taking an introductory psychology course ( $n = 135$  at Time 1,  $n = 161$  four weeks later at Time 2) completed questionnaires for class extra credit. One hundred and thirteen students (73 men and 40 women) who completed the questionnaires at both times were included in the analyses. There was no significant differences in study variables between participants who completed both questionnaires and those who completed only the Time 1 questionnaires,  $P_s > 0.2$ . The median age was 20 years (range was 19–33 years). Religious

1 affiliation was distributed as follows: Buddhist (5%), Catholic (13%), Protestant (31%), other  
2 (3%), and no religious preference (48%). Participants were categorized into two groups based on  
3 whether or not they were religiously affiliated. The questionnaires were presented in the partici-  
4 pants' native language, with scales translated into Korean by the first author, back-translated by  
5 a bilingual person, and then checked by the second author.

## 6 7 1.2. Measures

### 8 9 1.2.1. Spirituality

10 The 8-item Spiritual Transcendence Index (STI; Seidlitz et al., 2000) was used to assess indivi-  
11 dual differences in spirituality at Time 1 only. The STI refers to a subjective experience of the  
12 sacred that affects one's self-perception, feelings, goals, and ability to transcend difficulties. To  
13 accommodate different conceptualizations of spirituality, it refers specifically to "God" in one  
14 subset of four items (e.g. "I experience a deep communion with God") and to "spirituality" or  
15 "spiritual" in another subset of four items (e.g. "My spirituality gives me a feeling of fulfill-  
16 ment"). Spirituality, as measured by the scale, does not imply association with an identifiable  
17 religious group. Participants rated the items on a 6-point Likert scale (1 = extremely disagree and  
18 6 = extremely agree). The STI score is based on the average rating of the eight items, higher scores  
19 indicating higher spirituality. The test-retest reliability for the subscale, based on a four-week  
20 interval in the present study, was 0.86. Evidence for the validity of the STI is accumulating (Kim,  
21 Seidlitz, Ro, Evinger, & Duberstein, 2001; Seidlitz et al., 2000).

### 22 23 1.2.2. Coping

24 The 28-item COPE-S (Carver, 1997) was used to measure individual differences in various  
25 coping styles at Time 1 only. It included items measuring various strategies, such as self-distrac-  
26 tion, active coping, denial, substance use, use of emotional or instrumental support, disengage-  
27 ment, venting, positive reframing, planning, humor, acceptance, religion, and self-blame.  
28 Participants rated the items on a 4-point Likert scale (1 = I usually don't do this at all and 4 = I  
29 usually do this a lot). In an attempt to avoid conceptual overlap with spirituality, as measured by  
30 the STI, the religion subscale was excluded from a higher-order factor analysis of the other  
31 COPE-S subscales. The higher-order factor analysis with varimax rotation extracted five factors  
32 with eigenvalues greater than 1 (65.4% of the variance was explained). Planning, active coping,  
33 acceptance, and positive reframing loaded positively on the first factor (eigenvalue = 3.15), which was  
34 labeled *problem-focused coping*. Venting, self distraction, and use of instrumental support loaded  
35 positively on the second factor (eigenvalue = 1.84), which was named *venting*. Behavioral disengage-  
36 ment, self blame, and use of emotional support loaded positively on the third factor (eigenva-  
37 lue = 1.25), which was labeled *avoidance*. Denial and substance use loaded positively on the fourth  
38 factor (eigenvalue = 1.21), which was named *denial*. Finally, humor loaded on the fifth factor (eigen-  
39 value = 1.06), which was labeled *humor*. These five styles were created by summing relevant items and  
40 were used in the following analyses as measures of individual differences in coping strategies.

### 41 42 1.2.3. Stress

43 The 58-item College Student's Daily Events Scale (Won, Lee, & Kim, 1989) was used to assess  
44 the level of stress that participants experienced in their daily life at both Times 1 and 2. The scale



was developed with Korean college students and found to be reliable and valid (Won et al., 1989). The items were rated on an 8-point Likert scale (0 = not at all stressful and 7 = extremely stressful). Example items are "Someone did not keep an appointment with me." And "Could not finish projects that I planned for today." The average rating of the 58 items was used to indicate the level of daily stress.

#### 1.2.4. Emotional adjustment

The 20-item Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988), consisting of 10 positive and 10 negative affect adjectives, was used to assess the degree of individuals' emotional adjustment at both Times 1 and 2. Participants rated the items on a 5-point Likert scale (1 = not at all and 5 = extremely). Positive and negative affect scores were based on the average rating of the 10 adjectives comprising each scale. Higher scores on positive affect and lower scores on negative score indicate better emotional adjustment.

#### 1.2.5. Physical adjustment

The 36-item Cohen-Hoberman Inventory of Physical Symptoms (CHIPS; Cohen & Hoberman, 1983) measured physical symptoms that participants experienced during the past month, exclusive of psychological symptoms (e.g. depression), at both Times 1 and 2. Participants rated the items on a 5-point Likert scale (1 = not at all and 5 = extremely). The average rating of the 36 items was used to measure physical adjustment, higher scores indicating poorer physical adjustment.

## 2. Results

Means, S.D.s, and alphas of the study variables are shown in Table 1. All scales were reliable ( $\alpha$ s > 0.70, except venting and avoidance coping styles).

In order to examine the three research questions, Pearson correlations and a series of hierarchical regression analyses were performed. The hierarchical regressions examined effects on

Table 1  
Means, S.D.s, and alphas of study variables<sup>a</sup>

	Time 1			Time 2		
	Mean	S.D.	$\alpha$	Mean	S.D.	$\alpha$
STI	3.08	1.32	0.96			
Problem-focused	2.96	0.60	0.85			
Venting	2.48	0.57	0.67			
Avoidance	2.03	0.48	0.52			
Denial	1.84	0.69	0.70			
Humor	2.04	0.70	—			
Stress	1.97	0.86	0.94	2.04	1.03	0.96
Positive affect	2.64	0.64	0.81	2.66	0.67	0.82
Negative affect	2.38	0.61	0.81	2.42	0.69	0.84
Physical symptoms	0.85	0.49	0.91	0.93	0.59	0.93

<sup>a</sup> STI, Spiritual Transcendence Index. Problem-focused, Venting, Avoidance, Denial, and Humor are coping styles.

each of three dependent variables: positive affect, negative affect, and physical symptoms. In each regression, the initial score (Time 1) of the dependent variable was controlled for in step 1 and the initial score (Time 1) of stress level was controlled for in step 2. The nine main effect variables—spirituality, the five coping styles, stress at Time 2, and religious affiliation (1 for religiously affiliated and -1 for not religiously affiliated)—were entered in step 3. Thus, the main effect of stress at Time 2 indicates the unique contribution of stress to changes in the dependent variable over time, adjusting for initial stress (Cohen & Cohen, 1983). Two-way interaction terms between stress at Time 2 and spirituality, and stress at Time 2 and the five coping style scores were entered in step 4. A three-way interaction term among stress at Time 2, spirituality, and religious affiliation was entered in step 5. To reduce multicollinearity, predictor variables were centered on their sample means prior to the calculation of interaction terms (Aiken & West, 1991).

In figures provided to help interpret significant interaction effects, values for the dependent variable were calculated based on scores of the predictor variables that were one standard deviation above and one standard deviation below the means of the relevant predictor variables (Cohen & Cohen, 1983). These estimates were then used to calculate slopes for the dependent variable relevant to each predictor variable.

#### *Is spirituality related to better emotional and physical adjustment?*

The Pearson correlations reported in Table 2 revealed that the spirituality was not associated with stress, or with emotional or physical adjustment at either Time 1 or Time 2. In the series of hierarchical regressions reported in Table 3, the main effect for the spirituality (step 3), controlling for use of various coping strategies and changes in stress, was significant in change in negative affect but not significant for changes in positive affect or physical symptoms. These results suggest that spirituality directly related to adjusting to negative affect but spirituality may not be directly related to positive emotional and physical adjustment.

#### *Does spirituality moderate the impact of stress on adjustment?*

The hypothesized stress-moderating effects of spirituality on emotional and physical adjustment are also shown in Table 3. The stress $\times$ spirituality interaction effect (step 4) was significant on changes in both negative affect and physical symptom reports, but not on change in positive affect. As shown in Figs. 1 and 2, the positive relations between stress and both negative affect (Fig. 1) and physical symptom reports (Fig. 2) were weaker at higher levels of spirituality. These results suggest that spirituality buffered the effect of stress on negative affect and physical adjustment.

Next, we examined whether the stress moderating effects of spirituality were contingent on whether the participants were religiously affiliated. The three-way interaction in step 5 in Table 3 was significant on negative affect but not significant on physical adjustment. The result suggests that spirituality buffered the effect of stress on negative affect more for participants affiliated with a religious group than for those without religious affiliation. Spirituality, however, buffered the effect of stress on physical adjustment regardless of whether the participants were affiliated with a religious group.

Table 2  
Correlation coefficients among study variables<sup>a</sup>

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. STI	—												
2. Problem-focused	-0.10	—											
3. Venting	0.13	0.25**	—										
4. Avoidance	-0.02	0.07	0.29**	—									
5. Denial	-0.15	0.09	0.13	0.19*	—								
6. Humor	-0.01	0.24*	0.17	0.11	0.13	—							
7. Stress_T1	0.02	0.04	0.12	0.34***	0.15	0.05	—						
8. Stress_T2	0.06	0.03	0.11	0.24**	0.21*	0.06	0.69***	—					
9. PA_T1	0.09	0.31***	0.10	-0.20*	0.01	0.15	0.00	0.07	—				
10. PA_T2	0.01	0.24*	0.15	-0.13	0.19*	0.24**	0.11	0.19*	0.49***	—			
11. NA_T1	-0.03	0.03	0.03	0.27**	0.36***	0.05	0.27**	0.25**	0.24**	-0.01	—		
12. NA_T2	-0.08	0.04	0.06	0.08	0.27**	0.24**	0.40***	0.46***	0.10	0.34***	0.44***	—	
13. Symptom_T1	-0.08	-0.02	0.10	0.22*	0.20*	-0.07	0.32***	0.33***	0.03	-0.12	0.39***	0.24**	—
14. Symptom_T2	-0.08	0.03	0.09	0.18	0.23*	-0.07	0.38***	0.46***	0.11	-0.01	0.36***	0.45***	0.65***

<sup>a</sup> STI, Spiritual Transcendence Index; Problem-focused, Venting, Avoidance, Denial, and Humor are coping styles; T1, Time 1; T2, Time2; PA, Positive Affect; NA, Negative Affect; Symptom, Physical symptom reports

\*  $P < 0.05$

\*\*  $P < 0.01$

\*\*\*  $P < 0.001$

# Does spirituality influence the adjustment above and beyond various coping styles?

The correlations of the various coping styles with stress, positive affect, negative affect, and physical symptom reports at both measurement times are shown in Table 2. Problem-focused coping was associated with higher positive affect. Venting was unrelated to adjustment. Avoidance and denial were associated with higher negative affect and reported physical symptoms. Humor had inconsistent positive relations with both positive and negative affect. However, the main effects for coping styles on these variables were non-significant in the hierarchical regressions when adjusted for the baseline levels of the dependent variables and stress, and the concurrent levels of stress and spirituality, except for an effect of humor on negative affect (Table 3). Using humor as a coping style also moderated the association of stress and positive affect, such that participants who used humor to face stress reported higher positive affect. Problem-focused

Table 3  
Hierarchical regression analyses on adjustment outcomes<sup>a</sup>

	PA_T2		NA_T2		Symptoms_T2	
	$\beta$	$R^2\Delta$	$\beta$	$R^2\Delta$	$\beta$	$R^2\Delta$
<i>Step 1</i>						
Baseline DV at Time 1	0.49***	0.24***	0.44***	0.19***	0.65***	0.42***
<i>Step 2</i>						
Stress_T1	0.11	0.01	0.30***	0.08***	0.19*	0.03*
<i>Step 3</i>						
Stress_T2	0.16	0.09	0.34**	0.15**	0.24*	0.04
STI	-0.10		-0.22*		0.00	
Problem-focused (P)	0.07		-0.01		0.03	
Venting (V)	0.06		-0.01		0.01	
Avoidance (A)	-0.16		-0.16		-0.02	
Denial (D)	0.16		0.07		0.06	
Humor (H)	0.16		0.24**		-0.06	
Religiously Affiliated (RA)	0.15		0.21*		-0.05	
<i>Step 4</i>						
Stress_T2×STI	0.05	0.05	-0.19*	0.08*	-0.19*	0.05
Stress_T2×P	-0.09		-0.24**		-0.11	
Stress_T2×V	-0.13		0.10		0.10	
Stress_T2×A	-0.01		0.03		-0.13	
Stress_T2×D	0.04		0.05		0.09	
Stress_T2×H	0.20*		0.01		-0.07	
<i>Step 5</i>						
RA x Stress_T2×STI	-0.15	0.01	-0.21*	0.02*	-0.06	0.00

<sup>a</sup> T1, Time 1; T2, Time 2; STI = Spiritual Transcendence Index; Problem-focused, Venting, Avoidance, Denial, and Humor are coping styles; RA, 1 for religiously affiliated, -1 for not religiously affiliated; PA, Positive Affect; NA, Negative Affect; Symptom, Physical symptom reports

\*  $P < 0.05$

\*\*  $P < 0.01$

\*\*\*  $P < 0.001$



The findings of the stress-buffering effects of spirituality on negative affect and physical symptoms are consistent with previous studies on college students (Maton, 1989; Park et al., 1990) as well as on elderly populations (Hettler & Cohen, 1998; Kendler, Gardner, & Prescott, 1997; Tix & Frazier, 1998; Williams, Larson, Buckler, Heckman, & Pyle, 1991). While a stress-buffering effect of spirituality was found for Protestants, but not for Catholics, in the previous studies (e.g. Hettler & Cohen, 1998; Park et al., 1990; Tix & Frazier, 1998), in the present study, spirituality moderated the effects of stress regardless of religious affiliation. About half of participants in the present study indicated they did not have a religious affiliation. Thus, the findings in the present study were not limited to religious individuals, and suggest the possible usefulness of spirituality in coping in nonreligious populations. In addition, the present findings extended previous studies that focused on major stressors, showing that spirituality buffered the adverse effects of daily stressors.

As suggested by Seidlitz and colleagues (2000) and Hathaway and Pargament (1991), spirituality may be an important resource in transcending or ameliorating stressors, regardless of individuals' association with an identifiable religious group. The STI was specifically developed to omit reference to religion and to accommodate different conceptualizations of spirituality. The finding that spirituality, as measured by the STI, buffered the effects of stress in this Asian student sample, many of whom had no religious affiliation, indicates the importance of distinguishing spirituality from religiousness and the validity of the instrument. In addition, the results extend

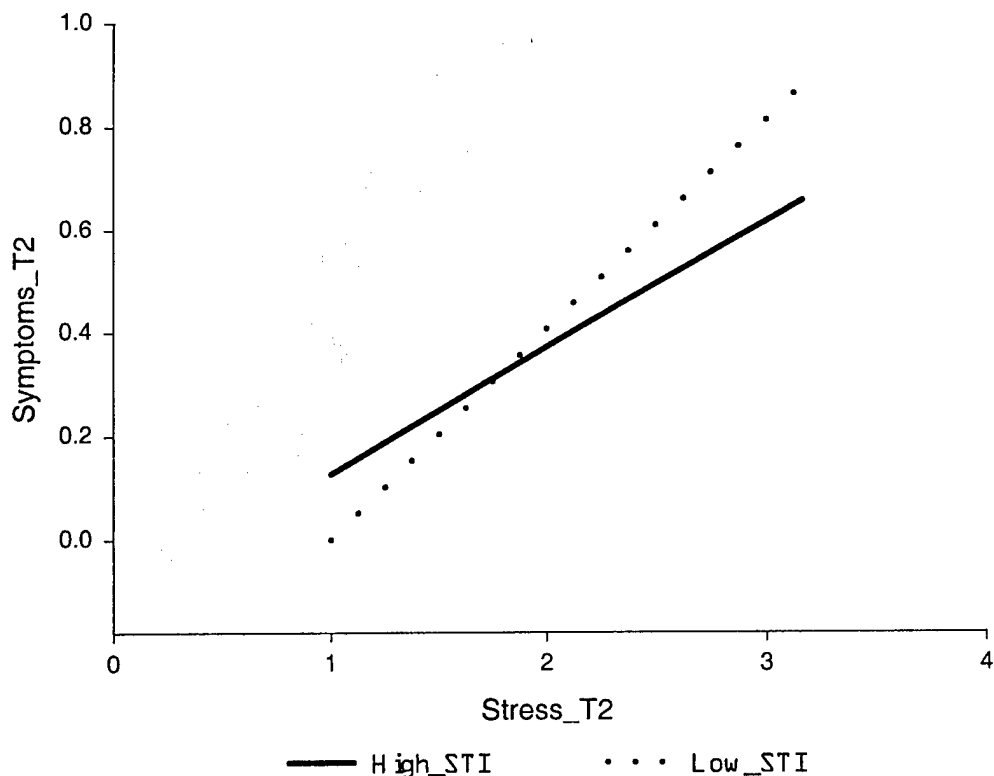


Fig. 2. STI's stress-buffering effect on physical symptom reports.

the literature to a non-Western population, which often has been neglected in the psychology of religion.

The STI conceives of spirituality as conferring four types of subjective benefits—cognitive, affective, motivational, and transcending. While these four influences or aspects of spirituality are reflected in the content of the STI, they are not independently measured and their specific effects in buffering stress require further study. The STI measures a perception of spiritual purpose and God's presence in one's life. We speculate that such perceptions may assist in coping with stressors by providing a broad positive perspective of one's life within which to understand and withstand difficulties that may arise. Spiritual people may be less distracted by problems or be less likely to overemphasize them, instead viewing difficulties as meaningful or even useful episodes in the larger context of life. Spiritual people as measured by the STI tend to experience feelings of fulfillment and deep communion with God. It is possible that these positive emotional experiences abide through the vicissitudes of life and provide inner strength and solace that guard against and help dispel feelings of anxiety or despair. The STI also measures the individual's perceived commitment to God and spirituality. The motivation towards spiritual experience and growth may provide a focus and direction to the person's life that is unshaken by difficulties or annoyances. While everyday problems may adversely affect other goals, the goal of maintaining and developing one's spirituality may be less subject to external disturbances, providing a continuous and fulfilling objective and direction to the person's life.

Finally, the STI measures the perception that the person's spirituality helps to transcend problems and maintain a sense of inner peace in spite of them. The fact that those scoring higher on the measure were less likely to report experiencing negative affect or physical symptoms in the face of higher stress is evidence that this transcending influence of spirituality was operative and valid. Future work is needed that examines whether each of these specific aspects of spirituality are involved in reducing the adverse effects of stress.

The stress-buffering effects of spirituality found in the present study were independent of other coping strategies. This finding supports Pargament's (1997) conclusion that religious coping accounts for unique variance in mental or physical health independent of the effects of non-religious coping, and is consistent with previous empirical studies (e.g. Pargament et al., 1999). It suggests that boosting spirituality may be one way to help students adjust to daily stress.

While the stress-buffering effect of spirituality was found on negative affect and physical adjustment, it was not found on positive affect. Consistent with findings that negative affect and positive affect are independent of each other (e.g. Watson et al., 1988), spirituality had different effects on these two types of affect. The effect of spirituality on positive affect has been understudied in previous research, thus, the lack of relation found in the present study should be replicated in future studies before firm conclusions are drawn. In addition, coping with different types of stressors may influence positive affect in different ways. For example, when individuals visualized their controllable stressful events and the emotions they had experienced, or visualized having resolved the problem, they reported more positive affect (Rivkin & Taylor, 1999).

In the present study, spirituality ameliorated the effects of perceived daily stress on self-reported negative affect and physical symptoms in Korean college students. Future studies should attempt to replicate the current findings with people in other age and cultures, over a longer time-frame, and using objective physical health measures. It may also be useful to assess specific adjustment indicators that are more critical for specific subgroups (e.g. drug abuse for adolescents; post-

partum depression for women who recently delivered babies). The findings have implications for promoting prevention programs that incorporate greater emphasis on spirituality as a way to improve people's coping skills.

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## THE DEVELOPMENT OF THE SELF-REGULATION OF WITHHOLDING NEGATIVE EMOTIONS QUESTIONNAIRE

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Based on the self-determination theory, a questionnaire was developed to measure individual differences in the Self-Regulation of Withholding Negative Emotions (SRWNE). Measurement reliability and validity concerning the scale were examined in three studies. Results in Study 1 demonstrated the distinctiveness of the SRWNE from emotional regulation measures, suggesting that the SRWNE may be appropriate to measure styles of self-regulation and to clarify the negative affect-health relation. In Study 2, test-retest reliability of scores on the SRWNE subscales was examined as was validity of the SRWNE with respect to coping strategies and health. The SRWNE was related to self-reports of health and may be relevant for predicting how people cope with stress. Study 3 compared a Korean sample with the U.S. sample in Study 2 and suggested construct comparability of the SRWNE across cultures and genders.

Research has documented a positive relation between expression of emotion and indices of health (see, e.g., Beutler, Engle, Oro-Beutler, Daldrup, & Meredith, 1986; Friedman & Booth-Kewley, 1987; Watson & Pennebaker, 1989). Accordingly, the relation of individual differences to the extent to which people withhold expression of emotion and various health outcomes has been extensively examined.

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Bonanno, Davis, Singer, and Schwartz (1991) and Weinberger (1990) identified a repressive personality style, and studies found that repressors relative to nonrepressors were more likely to develop cancer (Cox & Mackay, 1982) and had a shorter period of being recurrence free (Jensen, 1987). Further studies have related repressing, denying, or inhibiting negative emotions to asthma, cancer, coronary heart disease, and suppressed immune functioning (Goldstein, Edleberg, Meier, & Davis, 1988; Schwartz, 1990) and to lower survival rates after diagnosis (Dattore, Shontz, & Coyne, 1980).

However, the link between emotional expression versus withholding and health outcomes has been challenged by more complex findings. For instance, facial emotional expression has been found to attenuate arousal (Buck, 1984) as well as augment arousal (Lanzetta, Cartwright-Smith, & Eleck, 1976); cardiovascular disease has been related to emotional expression (Hecker, Chesney, Black, & Frautschi, 1988) as well as to inhibition of emotional expression (Haynes, Feinleib, & Kannel, 1980; King & Emmons, 1990). Furthermore, studies have found that conflict between a personal goal to express emotions and social norms against it was related to negative health symptoms (King & Emmons, 1991; Pennebaker & Lightner, 1988) and that inconsistency between people's personal styles and situationally prompted behaviors led to poor physiological indicators (Engebretson, Matthews, & Scheier, 1989; Richman, 1988).

Such results suggest the necessity of considering other individual differences as well as situational factors in the regulation of emotional expression. One example is King and Emmons's (1990) proposal that ambivalence about not expressing emotion, rather than inexpressiveness per se, is what fosters ill-being, and findings showed that ambivalence was positively associated with self-reported physical symptoms, the number of visits to health care providers, and depression (Katz & Campbell, 1994; King & Emmons, 1990). It thus appears that individual differences in emotional regulation, including the tendency to express negative emotions and ambivalence about expressing negative emotions, may influence health, although the process underlying the relations remains unclear. To help clarify the processes, self-determination theory (SDT) was employed for developing a scale to measure individual differences in emotional regulation.

#### *Internalization of Emotional Regulation*

SDT (Deci & Ryan, 1985b) distinguishes between two classes of intentional behavior: autonomous and controlled. Autonomous behavior is regulated through the process of choice and has an internal perceived locus of causality (deCharms, 1968). Controlled behavior is pressured or coerced by interpersonal or intrapsychic forces and has an external perceived locus of causality.

Internalization concerns the process of taking in an external regulation, and SDT distinguishes between types of internalization, which result in different types of regulation that can be ordered along the controlled-to-autonomous continuum (Ryan & Connell, 1989).

One type of internalization is referred to as introjection. It represents only a partial internalization and results in introjected regulation. This type of regulation, in which people pressure and coerce themselves to behave in particular ways, involves the implicit expectation of self-approval for compliance and self-derogation for noncompliance. Introjected regulation, which is essentially self-control, is phenomenally still closely anchored to external forces and is often prompted by the desire to avoid guilt or shame. When people withhold expression of negative emotion because they think they should and would feel ashamed if they did not, the regulation is introjected. Both external and introjected forms of regulation are considered relatively controlled and thus low in autonomy.

When people identify with a regulation and its value, the resulting regulation is called identified regulation. As members of a group or society, people may volitionally self-regulate in ways that are valued by that collective. For example, they may freely withhold a negative emotion because they personally value not disrupting a group process.

Finally, when internalization is complete, people will have integrated the identification with other aspects of their self and will be autonomous in the subsequent behavior. Integrated regulation of emotions involves being aware of one's emotions and regulating their expression with a full sense of choice. The goal of emotional integration is not to comply with social norms by suppressing strong inner urges; rather, it is to assimilate emotions and utilize inner experiences flexibly in acting autonomously. When an emotional regulation has been integrated, individuals experience little inner conflict about it and thus may evidence better health. Both identified and integrated regulations are considered relatively autonomous forms of internalized regulation.

The regulation for withholding expression of negative affect is broadly defined as the way in which individuals manage the experience and withholding of negative emotions and impulses. For example, when an event stimulates a negative emotion such as anger or fear, people might either express or not express that feeling through words or actions. According to SDT, having healthy outcomes associated with the inexpression of negative emotions requires the full internalization and integration of the regulation of the relevant emotional withholding. The withholding would be autonomous, and people would choose to withhold because it feels personally right to do so in that situation. In contrast, when controlled, people would suppress the feelings because they believe it is bad to have such feelings and/or to express them. They would experience conflict and tension, so less healthy outcomes would follow.

Autonomous self-regulation has been associated with well-being and other positive outcomes in a variety of settings including education (Grolnick, Ryan, & Deci, 1991), institutions for the aged (Kasser & Ryan, 1999), close relationships (Blais, Sabourin, Boucher, & Vallerand, 1990), political attitudes (Koestner, Losier, Vallerand, & Carducci, 1996), religious behavior (Ryan, Rigby, & King, 1993), and health care (Williams, Grow, Feedman, Ryan, & Deci, 1996).

The concept of individual difference in regulatory style for withholding negative affect is considered a relatively stable aspect of personality. That is, it is not a state that fluctuates easily as a function of the situation, but neither is it a stable trait that cannot be affected over time. Rather, it is relatively stable over time but can be influenced by factors such as therapeutic interventions.

### *Overview*

Study 1 was intended to develop an SDT-based measure of individual differences in people's motivation for withholding expression of negative affect. The scale assesses the degree to which people have internalized the rationale for withholding negative affect. The validity of the proposed scale was examined to determine the extent to which it is related (a) to other measures of emotion and emotion management (Study 1), (b) to measures of coping (Study 2), and (c) to global social contexts such as culture and gender (Study 3). The use of samples from different cultures was done to increase the generalizability of the proposed scale's reliability and validity.

### **Study 1: Development of the Self-Regulation of Withholding Negative Emotions Questionnaire (SRWNE)**

In this study, four SRWNE subscales (two controlled and two autonomous) were developed and validated. We used several validated measures of (a) constructs from SDT, (b) constructs concerning interpersonal styles, (c) emotion and emotion management constructs, and (d) general well-being constructs. The strategy involved conducting a factor analysis on all constructs and then relating the factor scores to the four SRWNE subscales and three indices. Scale validity would be supported by the controlled subscales and indices correlating negatively with positively toned factors (e.g., optimism) and correlating positively with negatively toned factors (e.g., social anxiety), whereas the autonomous subscales and indices correlated positively with the positively toned factors and correlated negatively with the negatively toned factors.

### *Method*

#### PARTICIPANTS

Participants were 168 college students (88 men, 79 women, 1 unspecified) who received course credit in a psychology course at the University of Rochester. Participants worked in small groups of as many as 20 to complete a packet of questionnaires. Participants were fully debriefed.

#### THE SRWNE

An initial pool of 33 items represented the four self-regulatory styles (Ryan & Connell, 1989): external regulation (7 items), introjected regulation (9 items), identified regulation (7 items), and integrated regulation (10 items). The number of items was relatively small for a scale construction project. However, the items were all adapted from self-regulation questionnaires that used the SDT framework and were validated in different domains, so we assumed we would be able to select a subset of these items that would yield adequate reliability coefficients.

The scale was constructed to assess the motivational reasons for withholding expression of negative emotions using two stems: "Why do you not express your negative emotions to other people?" (17 items) and "Why do you sometimes act like everything is all right, even though you are upset?" (16 items). Participants responded to the randomly ordered 33 items on a 7-point scale anchored by 1 = *strongly disagree* and 7 = *strongly agree*. A composite score for each of the four subscales was obtained by averaging the relevant items in that subscale across the two stems.

Sample items are the following: for external regulation, "I'm afraid that people wouldn't like me if I expressed my feelings"; for introjected regulation, "I don't think I have the right to bother other people with my negative feelings"; for identified regulation, "It is important for me personally not to be hurtful to others"; and for integrated regulation, "I find it personally satisfying to be able to feel my emotions without letting them be disruptive."

To improve the internal consistency of each subscale, one item was dropped from the introjected pool, three items were moved from the integrated subscale to the identified subscale based on correlations among the two subscale items (the identified and integrated subscales share a theoretical boundary on the self-determination continuum), and two items were dropped from the initial identified pool and two from the integrated pool due to low item-total correlations.

The resulting 28-item SRWNE scale appears in the appendix, and Table 1 shows descriptive statistics for the scale. The four SRWNE subscales were shown to have adequate reliabilities ( $.67 < \alpha_s < .78$ ). The simplex structures of the SRWNE were supported by the pattern of correlations in Table 2, in

Table 1  
Means and Standard Deviations for the Self-Regulation of Withholding Negative Emotions  
Questionnaire Subscales (Study 1, Final 28-Item Scale)

	Number of Items	<i>M</i>	( <i>SD</i> )	$\alpha$	Men	Women	<i>t</i> (165)
External regulation	7	3.69	(1.04)	.75	3.69	3.68	.05
Introjected regulation	8	3.48	(1.05)	.78	3.58	3.36	1.37
Identified regulation	8	4.53	(0.81)	.67	4.48	4.58	-.79
Integrated regulation	5	4.29	(1.17)	.73	4.44	4.13	1.78
Controlled index		0.00	(1.86)	.85	.09	-.13	.77
Autonomous index		.00	(1.73)	.78	.07	-.08	.55
Relative autonomous index		.00	(1.79)	.88	-.02	.05	-.26

Table 2  
Pearson Correlation Coefficients Among the Self-Regulation of Withholding Negative  
Emotions Subscales and Indices (Study 1 and Study 3)

	1	2	3	4	5	6	7
1. External regulation	—	.64	.49	.34	.91	.48	-.47
2. Introjected regulation	.69	—	.56	.26	.91	.47	-.48
3. Identified regulation	.32	.51	—	.49	.58	.86	.26
4. Integrated regulation	.35	.34	.50	—	.33	.86	.52
5. Controlled index	.92	.92	.46	.37	—	.53	-.52
6. Autonomous index	.38	.49	.87	.87	.47	—	.45
7. Relative autonomy index	-.56	-.46	.37	.45	-.55	.45	—

Note. All correlation coefficients are significant at  $p < .001$ . Correlation coefficients above the diagonal are for Study 1 and below the diagonal are for Study 3. All correlation coefficients reported in this table were significant with the Bonferroni procedure (Rosenthal & Rosnow, 1991).

which subscales were more strongly correlated with others that are theoretically adjacent than with those that are more distant.

Subscale scores were standardized, and the standardized scores for external and introjected regulation were added to form a controlled index (CI) for withholding emotions. The standardized scores for identified and integrated regulation were added to create an autonomy index (AI), and a relative autonomy index (RAI) for withholding expression was created by subtracting the CI from the AI. Table 2 shows the correlations of the four SRWNE subscales with the three indices.

*t* tests were performed to examine gender differences on each subscale and index. As shown in Table 1, there were no significant gender differences on the subscales or indices, although men scored marginally higher than women on integrated regulation,  $t(1, 165) = 1.78$ ,  $p = .09$ . At the item level, men scored higher than women on Items 3, 24, and 28.



## Other Measures

*General Causality Orientations Scale.* This 36-item scale (Deci & Ryan, 1985a) assesses individual differences in general motivational orientations: autonomy orientation, control orientation, and impersonal orientation. Only the autonomy and control orientations were used.

*Self-Determination Scale.* This 10-item scale (Sheldon & Deci, 1996) assesses a general tendency to be in contact with oneself and to feel a sense of choice in one's actions.

*Attachment style.* Four prototypic attachment patterns are described that result from a combination of people's positive and negative concepts of themselves and close others (Bartholomew & Horowitz, 1991). The four styles differ in their degree of attachment security, and participants get a score on each.

*Self-Consciousness Scale.* Developed by Fenigstein, Scheier, and Buss (1975), the 23-item scale measures three aspects of self-consciousness: private self-consciousness, public self-consciousness, and social anxiety.

*Trait Meta-Mood Scale.* This scale (Salovey, Mayer, Goldman, Turvey, & Palfai, 1995) measures individuals' ability to identify feelings and regulate these feelings adaptively. The short form has 24 items to measure individual differences in attention to mood, discriminating among feelings, maintaining positive moods, and repairing negative moods.

*Negative Mood Regulation.* Catanzaro and Mearns (1990) developed a 30-item measure of generalized beliefs that behaviors or cognitions can alleviate a negative mood state.

*Ambivalence Over Emotional Expressiveness Questionnaire.* This 28-item scale (King & Emmons, 1990) measures ambivalence about revealing versus hiding emotions.

*Emotional Expressiveness Questionnaire.* King and Emmons (1990) also developed a 16-item scale to measure the tendency to express a variety of positive and negative emotions.

*Weinberger Adjustment Inventory-Short Form.* This 35-item measure assesses socioemotional adjustment for nonclinical populations (Weinberger, 1990).

*Life Satisfaction.* This 5-item scale (Diener, Emmons, Larsen, & Griffin, 1985) measures global cognitive-judgmental aspects of subjective well-being.

*Center for Epidemiological Studies Depression Scale (CES-D).* This 20-item measure assesses depressive symptoms within the general population (Radloff, 1977).

*Cohen-Hoberman Inventory of Physical Symptoms (CHIPS).* The 36-item scale measures physical ailments and excludes psychological symptoms (Cohen & Hoberman, 1983).

### Results

#### CORRELATIONS AMONG MEASURES

The factor analysis of the emotion measures (with varimax rotation) examined the underlying structural relationship among the measures. Using the rule of eigenvalue greater than 1.0, five meaningful factors emerged, accounting for 60.7% of the variance of the original measures.

The first factor (eigenvalue = 6.35) was labeled *optimism*, with negative mood regulation, repair, life satisfaction, self-determination, restraint, and clarity as its positive indicators and CES-D, distress, and CHIPS as its negative indicators. The second factor (eigenvalue = 2.25) was labeled *social anxiety*. It has ambivalence about emotional expressiveness, social anxiety, and preoccupied attachment as its positive indicators and emotional expressiveness as its negative indicator. The third factor (eigenvalue = 1.56), named *awareness*, has attention, private self-consciousness, and autonomy orientation as its positive indicators. The fourth factor (eigenvalue = 1.36) was labeled *mistrust of others*, and it has the fearful and dismissing attachment styles as its positive indicators and the secure attachment style as its negative indicator. Finally, the fifth factor (eigenvalue = 1.23) was called *external focus*, with the control orientation and public self-consciousness as its positive indicators.

The five factor composites were subjected to Pearson correlational analyses with four SRWNE subscales and three indices (upper half of Table 3). As expected, controlled SRWNE (i.e., external and introjected regulation and CI) was positively associated with negative indicators of affect status. The controlled SRWNE related to pessimism, social anxiety, mistrust of others, external locus of causality, and lack of emotional awareness. Also, as expected, the autonomous SRWNE (i.e., identified and integrated regulation and autonomous index) related negatively to negative indicators of affect status. However, autonomous SRWNE also related positively to social anxiety and mistrust of others, which suggests that no matter what one's reasons for

Table 3

*Pearson Correlation Coefficients Between Self-Regulation of Withholding Negative Emotions Subscales and Indices and the Higher-Order Factors of the Emotion Measures (Study 1) and the Coping/General Health Measures (Study 2)*

	ER	JR	DR	TR	CI	AI	RAI
Study 1							
Factor 1:							
optimism	-.39****	-.34****	.02	.09	-.40****	.06	.48****
Factor 2:							
social anxiety	.61****	.51****	.29****	.09	.60****	.22***	-.41****
Factor 3:							
awareness	-.10	-.23***	.00	.08	-.18**	.04	.23***
Factor 4:							
mistrust of others	.26****	.28****	.20***	.24***	.29****	.26***	-.05
Factor 5:							
external focus	.31****	.16**	.02	.01	.26****	.01	-.25***
Study 2							
Factor 1:							
psychosomatics	.36****	.32****	.08	-.01	.37****	.04	-.34****
Factor 2:							
problem-focused	-.23****	-.20****	.07	.23****	-.23****	.17***	.40****
Factor 3:							
support seeking	-.13**	-.27***	-.13**	-.08	-.22****	-.12**	.11*
Factor 4:							
denial	.34****	.26****	.04	.11*	.32****	.08	-.25****
Factor 5:							
rumination	.33****	.31****	.16***	.16***	.34****	.18***	-.18***
Factor 6:							
acceptance	-.03	-.03	.11*	.22****	-.03	.19****	.21****

Note. ER = external regulation; JR = introjected regulation; DR = identified regulation; TR = integrated regulation; CI = controlled index; AI = autonomous index; RAI = relative autonomy index.  $N = 168$  (Study 1);  $N = 305$  (Study 2). With the Bonferroni procedure, correlation coefficients for Study 1 may be due to chance if the significance level fails to reach  $p < .01$ , and correlation coefficients for Study 2 may be due to chance if the significance level fails to reach  $p < .009$ .

withholding negative emotion, the withholding is related to social anxiety and mistrust. Finally, RAI was related to optimism, emotional awareness, internal locus of causality, and lack of social anxiety.

In general, the controlled SRWNE subscales showed stronger correlations with emotion measures than did the autonomous subscales. This suggests that the emotion measures may be reflecting aspects of emotional regulation that are controlled to varying degrees by interpersonal or intrapersonal forces, rather than reflecting characteristics that involve choice by the self.

In sum, Study 1 provided preliminary reliability and validity evidence with regard to the SRWNE scale. Two additional studies were performed to further examine the validity of the SRWNE.

### Study 2: Validity and Reliability

Emotional self-regulation involves coping with stress, and the types of emotional regulatory processes one employs may result in different mental and physical consequences. Thus, the extent to which the SRWNE relates to measures of coping and general health was explored in Study 2.

#### *Method*

##### PARTICIPANTS

A total of 305 psychology students (96 men, 209 women) completed a questionnaire packet (including the SRWNE) at the beginning of a semester (Time 1) and completed the SRWNE questionnaire again approximately 8 weeks later (Time 2).

##### MEASURES

The questionnaire packet included the 28-item SRWNE and the following measures.

*General affect.* A 20-item Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1988) assessed general feelings using a 5-point Likert-type response format. Scores for the 10 positive and 10 negative adjectives were averaged within subscales to form composite scores for general positive affect and general negative affect.

*Coping.* A 72-item revised COPE (Zuckerman & Gagne, 2000) measured 18 coping strategies: 10 original COPE subscales (Carver, Scheier, & Weintraub, 1989), 1 revised subscale, and 7 additional ones. A 4-point Likert-type response format was used. Coping strategies were active coping, planning, suppression of competing activities, restraint coping, instrumental support seeking, positive interpretation, acceptance, denial, behavioral disengagement, emotional support seeking, mental disengagement, expressing emotion, understanding emotion, repairing emotion, other blame, replacement, self-focused rumination, and self-blame.

*General health.* A 28-item General Health Questionnaire (Golberg & Hillier, 1979) assessed mental and physical health status concerning anxiety, depression, social dysfunction, and somatics using a 4-point Likert-type response format. Participants rated the extent to which they experienced each symptom during the previous 3 weeks. A general health composite was formed by reversing and averaging the four subscale scores. Higher scores indicate better health.

Table 4  
Means, Standard Deviations, and Alphas of Self-Regulation of Withholding Negative Emotions Subscales (Study 2 and Study 3)

	Study 2						Study 3		
	Time 1			Time 2					
	<i>M</i>	<i>SD</i>	$\alpha$	<i>M</i>	<i>SD</i>	$\alpha$	<i>M</i>	<i>SD</i>	$\alpha$
External regulation	3.55	1.21	.79	3.48	1.27	.83	4.83	1.40	.79
Introjected regulation	3.30	1.20	.83	3.24	1.21	.85	4.86	1.12	.71
Identified regulation	4.48	1.03	.77	4.55	0.99	.76	5.96	1.05	.68
Integrated regulation	4.38	1.29	.76	4.38	1.30	.80	4.33	1.44	.70
Controlled index	0.00	1.87	.89	0.00	1.87	.90	0.00	1.84	.85
Autonomous index	0.00	1.79	.84	0.00	1.79	.85	0.00	1.73	.78
Relative autonomy index	0.00	1.81	.91	0.00	1.77	.92	0.00	1.83	.87

### Results

Means, standard deviations, and alphas for the SRWNE subscales at Time 1 and Time 2 are reported in Table 4. Scores were adequately reliable ( $\alpha$ s > .75), and 8-week test-retest reliability coefficients were also adequate ( $r$ s > .61,  $p$ s < .001). The SRWNE subscales yielded a simplex structure at both times (not presented in the table), and a series of  $t$  tests revealed no gender differences on the subscale scores.

### RELATIONS AMONG CONSTRUCTS

The subscale scores of the coping and general health measures were subjected to a factor analysis with varimax rotation to examine underlying structure among the measures. The analysis extracted six factors with eigenvalues greater than 1 (64.8% of the variance explained). The first factor (eigenvalue = 5.50), labeled *psychosomatics*, has general health composite, anxiety, somatics, depression, negative affect, and dysfunction as its indicators. The second factor (eigenvalue = 4.38), labeled *problem-focused coping*, has active coping, planning, positive interpretation, positive affect, and repairing as its indicators. The third factor (eigenvalue = 1.95), labeled *support seeking*, has emotional support seeking, expressing emotion, instrumental support seeking, and understanding emotion as its indicators. The fourth factor (eigenvalue = 1.81), labeled *denial*, has behavioral disengagement, denial, other blame, mental disengagement, and replacement as its indicators. The fifth factor (eigenvalue = 1.44), labeled *self-blame*, has self-blame and self-focused rumination as its indicators. The sixth factor (eigenvalue = 1.34), labeled *acceptance*, has acceptance and restraint coping as its indicators. Factors 2, 3, and 5 are positive factors, whereas 1, 4, and 6 are negative.

The six factor composites were then subjected to Pearson correlational analyses with four SRWNE subscales and three indices (the lower half of Table 3). Controlled SRWNE subscales and index were expected to be positively related to the negative factors and negatively related to the positive ones. They related as predicted to all except Factor 6, acceptance. Autonomous SRWNE subscales and indices were expected to be negatively related to negative factors and particularly related to positive factors. These relations were weaker than the ones for controlled regulation. Further autonomous regulation was positively associated with rumination and negatively associated with support seeking, which suggests that no matter what one's reasons for withholding negative emotion, the withholding is related to self-focused rumination and avoiding social support.

The results in Study 2 showed acceptable test-retest reliability for scores on the SRWNE and demonstrated that the SRWNE construct was related to various coping styles and health outcomes in the theoretically expected directions. The SRWNE subscales were also associated with mental and physical adjustment measures as would be expected.

### Study 3: Comparability Test of the SRWNE

Emotional self-regulation requires internalizing values and regulatory processes, resulting in individual differences in the regulation of emotions. SDT posits that the internalization process is universal but that cultures may differentially facilitate or inhibit individuals' internalization process. For example, collectivistic cultures, such as in Korea, compared to individualistic cultures, such as in the United States, emphasize collective identity, emotional dependence, and behavioral regulation by in-group norms (Bond, 1998; Kim, 1994; Triandis, McCusker, & Hui, 1990). Such emphasis on establishing an interpersonal harmony and considering in-group members' well-being as they deal with their own emotions, may be perceived as pressure or external control and could result in individuals in Korean culture engaging in more controlled emotional regulation than those in the U.S. culture. This study examined these issues. In addition, in this study, we also examined the influence of gender on the internalization of the value of emotional withholding by Americans and Koreans (Cross & Madson, 1997).

#### *Method*

##### PARTICIPANTS

A total of 326 college students (153 men, 173 women) at Yonsei University, Seoul, South Korea, volunteered to complete the 28-item SRWNE.

Table 5  
*Unstandardized Estimates of Construct Means and Standard Deviations for the Self-Regulation of Withholding Negative Emotions Subscales and Correlations Among the Subscales*

Group	ER	JR	DR	TR
Mean				
Korean men	0.00	0.00	0.00	0.00
Korean women	-0.04	0.20	-0.04	-0.05
U.S. men	-1.24****	-1.37****	-1.10****	-0.11
U.S. women	-1.26****	-1.56****	-1.18****	-0.14
Standard deviation				
Korean men	1.00	1.00	1.00	1.00
Korean women	1.20	1.05	0.93	1.16
U.S. men	0.84	0.93	0.91	0.78
U.S. women	0.98	1.03	0.98	0.83
Correlation				
Korean women				
Korean men				
ER	—	.99	.55	.45
JR	.97	—	.42	.43
DR	.51	.65	—	.63
TR	.61	.75	.83	—
U.S. Women				
U.S. men				
ER	—	.93	.64	.41
JR	.99	—	.74	.49
DR	.56	.68	—	.71
TR	.50	.41	.84	—

Note. ER = external regulation; JR = introjected regulation; DR = identified regulation; TR = integrated regulation. The group of Korean men was a reference group ( $M = 0$ ,  $SD = 1$ ). All  $SD$ s were significantly different from the reference group at  $p < .001$ .

\*\*\*\* $p < .001$ .

### Results

Means, standard deviations, and alphas for the SRWNE subscale scores are reported in Table 5. Correlations among SRWNE subscales, which are below the diagonal in Table 2, support the simplex structure. A series of  $t$  tests revealed no gender differences on SRWNE subscales.

#### TEST FOR MEASUREMENT COMPARABILITY OF THE EMOTIONAL SELF-REGULATION CONSTRUCT

A confirmatory factor analysis was conducted to examine the equivalence of measurement structure of the SRWNE questionnaire (construct comparability) across two cultures and two genders, comparing Study 2 and Study 3 data sets. To examine the mean level relations across two cultures and two

genders, multiple-group mean and covariance structures analysis with AMOS 4.0 (Arbuckle & Wothke, 1999; Little, 1997) was used. Two questions could be answered: (a) whether the same underlying structure exists across multiple groups (i.e., measurement equivalence of the constructs) and (b) whether the different cultural groups have the same means on the latent constructs. We used four fit indices: root mean squared error of approximation (RMSEA), normed fit index (NFI), Tucker-Lewis Index (TLI), and comparative fit index (CFI). Adequate fit of a specified model to the data is indicated when the RMSEA has a value less than .05 (Browne & Cudeck, 1993) and the NFI, TLI, and CFI have values greater than .9 (Marsh, Balla, & McDonald, 1988; Tanaka & Huba, 1989).

*Model specification.* For each construct of SRWNE, multiple indicators were created by averaging two to four items within each relevant subscale. For external regulation (ER), introjected regulation (JR), and integrated regulation (TR), two observed indicators were created for each construct (er1 and er2 for ER, jr1 and jr2 for JR, and tr1 and tr2 for TR), and for identified regulation (DR), three observed indicators (i.e., dr1, dr2, dr3) were created. Creating multiple observed indicators for each construct allows for measurement error, thus improving the fit of the measurement model. The four constructs were allowed to correlate with each other, reflecting the simplex structure of the SRWNE scale. Each observed variable was constrained to be the indicator of one construct only. Elements in the error matrices of the observed variables were freed to correlate diagonally. In addition, measurement error variances between er2 and tr2, jr2 and dr1, jr2 and dr2, jr2 and dr3, and dr1 and tr1 were freed to correlate with each other to improve the model fit. All other off-diagonal elements in the error matrices were fixed to zero. These specifications were equated across two cultures and two gender groups.

The fit of the specified model with no cross-group equality constraints showed satisfactory fit (RMSEA = .03, NFI = .96, TLI = .99, and CFI = .98), indicating that the general structure is tenable. To test for measurement equivalence, invariance of the factor pattern coefficients was enforced. The overall model fit was still quite satisfactory (RMSEA = .04, NFI = .95, TLI = .99, and CFI = .97). Then, invariance of the intercepts was added and the overall model fit was marginally acceptable (RMSEA = .10, NFI = .96, TLI = .94, and CFI = .96). The results indicate that the SRWNE constructs have equivalent measurement properties and are comparable across culture and gender groups examined here (see Little, 1997).

#### TESTS FOR SOCIOCULTURAL DIFFERENCES ON AUTONOMOUS REGULATION OF WITHHOLDING

Because construct comparability was tenable, equality of the latent means and equality of the latent covariance structures were tested across the four



groups. All corresponding parameters (viz., factor pattern coefficients, intercepts, and error variances of observed variables) were freed for the first group and set to be invariant for the other groups. The estimated latent factor means were fixed to 0 and standard deviations were fixed to 1 in the first group and freed in the subsequent groups; thus, a given construct's mean and standard deviation could be identified and estimated as a relative difference from the reference point estimated in the first group (McArdle & McDonald, 1984). The covariances among factors were freed in the first group and estimated in the subsequent groups using the same pattern and starting value with the first group.

The fit of the specified model for both cultures and genders without equal constraints on construct means and variances was satisfactory,  $\chi^2(158) = 644.32$ , RMSEA = .07, NFI = .96, TLI = .97, and CFI = .97. When only the construct means were specified as invariant, the fit of the model was satisfactory but significantly worsened,  $\chi^2(170) = 932.21$ , RMSEA = .09, NFI = .95, TLI = .95, and CFI = .95;  $\chi^2_{\text{diff}}(12) = 287.89$ ,  $p < .01$ . When only the covariance structure was specified as invariant without equality constraint on construct means, the fit of the model was again satisfactory, but the difference was statistically significant,  $\chi^2(170) = 680.25$ , RMSEA = .07, NFI = .96, TLI = .97, and CFI = .97;  $\chi^2_{\text{diff}}(12) = 35.93$ ,  $p < .01$ .

As shown in the upper portion of Table 5, differences in construct means were found between cultures but not between genders. The construct means for external regulation, introjected regulation, and identified regulation were significantly higher for Koreans than for Americans, whereas the construct mean for integrated regulation was not significantly different by gender group ( $ps > .27$ ). The construct variances for all four constructs, shown in the middle portion of Table 5, were significantly different for all three comparison groups from the reference group of Korean men. Correlations among four latent variables across the groups are reported in the bottom portion of Table 5. Correlation between introjected and integrated regulation was greater for the group of Korean men than for other groups. Correlations between identified and integrated regulation and between introjected and identified regulation of Korean men were greater than those of Korean women.

In sum, the measurement of autonomous emotional regulation was comparable across countries and genders, but the means were different between cultures and the variances were different among culture-gender groups. Correlations between subscales seemed greater for Korean men than for the other groups.

### General Discussion

Three studies presented initial evidence for the reliability and validity of individual difference scores for people's motivation to withhold expression

of negative affect. The scale is intended for use in studies examining issues concerning the relation of negative affect to health.

#### *The SRWNE as an Emotion Regulation Measure*

The studies showed validity evidence for the SRWNE scale. For example, the SRWNE subscales were correlated with various emotion management scales and with various coping strategies in the expected directions. In particular, expressing emotions and repairing emotions related to the SRWNE subscales in a way that provided convergent validity while showing that different SRWNE subscales predicted different coping strategies.

#### *Measurement Equivalence of the Autonomous Emotional Regulation Constructs*

The structure of the SRWNE appears comparable across cultures and genders, although the construct means were different in the two cultures. Koreans scored higher than Americans did on controlled emotional regulation (i.e., external and introjected regulation) and on identified regulation. The neo-Confucian theory of emotion (see Hahn & Chon, 1994), which has been embedded in Koreans' psychological characteristics, emphasizes a balance between personal and social appropriateness in emotional regulation. "We-ness" (Choi & Choi, 1994), viewed as Koreans' indigenous psychology, reflects both the synthetic collectivism based on genuine concern for others over the self and an unconditional emotional bond with the collective based on pursuing social interest that is in harmony with personal fulfillment (Hahn & Chon, 1994). We-ness regarding emotional regulation in Korea seems to be perceived as pressure or external control, resulting in Koreans' being more controlled in emotional regulation than are Americans. However, Koreans also scored higher on identified regulation, suggesting that Koreans, relative to Americans, are also more characterized by believing it is personally important to regulate their negative emotions for the good of the collective group.

#### *Future Research and Conclusions*

Because chronic dysfunctional emotional regulation has been associated with physical illnesses such as arthritis, asthma, breast cancer, and coronary heart disease (see Pennebaker, 1995), it is necessary to examine styles of emotional self-regulation and physical health using a longitudinal format and diverse populations to ascertain whether more autonomous styles of regulation can buffer the adverse effects of stress on health. If it does, an interven-

tion to foster more autonomous emotional regulation may help ameliorate serious long-term physical risks.

All three studies were based on self-report data, which is a limitation; therefore, behavioral and physiological data should be included in future work.

In sum, reasonable reliability and validity were obtained concerning the SRWNE Questionnaire in three studies using college students from two cultures, indicating that the style of regulating the expression of negative emotions does seem to make a difference regarding coping and health.

Appendix  
Self-Regulation of Withholding  
Negative Emotions (SRWNE) Questionnaire

There are a variety of reasons **when I do not express my negative emotions to other people**. Please read over the questions and indicate how much you agree or disagree with each reason using the scale provided.

Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree
1	2	3	4	5	6	7

**The reason I do not** express my negative emotions to other people is because:

ER 1. I think others would be upset with me, if I expressed these feelings.

JR 2. I would feel guilty if I let my bad feelings come out.

TR 3. I find it personally satisfying to be able to feel my emotions without letting them be disruptive.

JR 4. Expressing negative emotions would just hurt others, and a person shouldn't do that.

DR 5. There are some situations where it is useful to express my feelings and others where it's not.

JR 6. I would feel like a bad person if I expressed my bad feelings to my friends.

ER 7. My parents and friends expect me to control myself.

TR 8. I enjoy being aware of my feelings but I also find it satisfying to maintain a positive outward appearance.

DR 9. It is important to me personally not to be hurtful to others.

JR 10. I don't think I have the right to bother other people with my negative feelings.

DR 11. As a caring person, I do not want to upset others with my negative feelings.

ER 12. I'm afraid that people wouldn't like me if I express my feelings.

DR 13. It is important to be aware of my negative feelings, but if I keep them to myself it is to maintain emotional stability.

There are a variety of reasons **why I sometimes act like everything is all right, even though I am upset.** Please read over the questions and indicate how much you agree or disagree with each reason using the scale provided.

Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree
1	2	3	4	5	6	7

**Sometimes when I am upset, I act like everything is all right, because:**

JR 14. I'd be ashamed of myself if I let my bad feelings come out.

DR 15. The important thing is to understand my own upset, but it may not be useful to tell others about it.

ER 16. I think it could ruin my relationships if I am always talking about what bothers me.

DR 17. It is important to me not to burden others with my problems.

TR 18. It is gratifying to be able to keep my upset from interfering with my goals.

ER 19. I want others to think I'm mature.

TR 20. It is an interesting challenge to remain calm and not always be getting upset.

JR 21. I would be embarrassed if I let others see what was bothering me.

DR 22. I feel that it is mature to maintain a positive attitude.

TR 23. It is fulfilling to be able to achieve my goals even when I am upset.

JR 24. I believe people should keep their upset to themselves.

ER 25. I'm afraid people won't like me if I let on what is wrong.

DR 26. I choose to keep my bad feelings to myself so I can accomplish important projects.

ER 27. I think I have to follow the social norms.

JR 28. I want others to think I'm a good person.

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ER = external regulation; JR = introjected regulation; DR = identified regulation; TR = integrated regulation.

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The Effects of Information and Negative Affect on Severity of Side Effects  
from Radiation Therapy for Prostate Cancer

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**Abstract**

A randomized clinical trial with 152 patients was conducted to examine the effects of an informational intervention on the severity of side effects resulting from radiation therapy for prostate cancer. We also examined negative affect both as a predictor and as an outcome variable. The informational intervention, given to patients at the first and fifth treatments, was based upon self-regulation theory and provided patients with specific, objective information about what to expect during their radiation treatments. Patients in the comparison group received general information at the same point in time. Negative affect was measured using the Profile of Mood States (POMS) prior to the intervention and at the last treatment. The severity of side effects for each individual was assessed at their last treatment. The results showed that patients in the informational intervention group reported significantly fewer problems with sleep and less fatigue (marginally significant) than those in the comparison group. Negative affect was not influenced by group assignment. Baseline negative affect was not related to symptom development, although the development of side effects was associated with an increase in negative mood. The results suggest that patients could benefit from increased knowledge about what to expect during their radiation treatments.

**Key Words:** Side Effects; Radiation Therapy; Informational Intervention; Negative Affect

## Introduction

More than a million Americans are diagnosed with cancer every year (Cancer Facts and Figures, 2000), and radiation therapy (RT) is a commonly used treatment for its control or eradication. Localized radiation treatment, however, has been associated with a wide array of side effects [1-3]. Among those, fatigue is one of the most frequent and is significant problem associated with both radiation and chemotherapy treatments for cancer as noted in two recent reviews [4, 5] and in two epidemiological studies [6, 7]. Sleep disturbance, also a common side effect, has been reported more often by those patients who were closer to completion of their course of RT treatments [2, 3, 8]. Approximately 75% of prostate cancer patients undergoing RT (the targeted group in the current study) report having side effects, including diarrhea, fatigue, skin reactions, sleep problems, and urinary problems [9, 10]. The severity of side effects resulting from RT has been significantly associated not only with disruption in daily activities and a poorer quality of life, but also with psychological distress, as indicated by an increase in anxiety, anger, and depression [11, 12].

Few theories relating to the psychosocial characteristics of patients with severe side effects have been examined in well-designed clinical studies [3, 13]. Two theoretical perspectives, the first pertaining to information processing and the second to negative affectivity, were utilized in the design of the present study, examining the relationship among negative mood, type of information received and treatment-related side effects.

### Self-Regulation Perspective

Previous research has indicated that the majority of patients who received RT wanted to have more information about it [14] and that greater uncertainty concerning the treatment has been associated with increased adjustment problems [11, 15]. Self-regulation theory offers explanations for human behaviors from a cognitive information processing perspective. It posits that a concrete, objective, cognitive representation of an event allows for coping better by reducing negative mood and disruption in normal daily activities. The objective features of an event include four dimensions: (a) ~~(a)~~ physical sensations (i.e., that which is felt, heard, tasted, smelled, and seen), (b) temporal features (e.g., sequence and duration of events), (c) environmental features (e.g., people involved and characteristics of the setting), and (d) the cause of the sensation or event [16].

According to self-regulation theory, when preparatory information contains a description of concrete, objective features of an impending event, patients will anticipate these unambiguous features and they will monitor the experience for either their presence or absence. This reduction of an abstract experience (e.g., being treated for cancer) to specific elements (e.g., I will lie on a table; I will hear a warning tone, etc.) is thought to reduce generalized anxiety and to foster a problem-solving approach to unpleasant aspects of the experience [17]. Experimental interventions examining this model in patients undergoing surgery, chemotherapy, and RT have had positive results and have resulted in decreased disruption in normal daily routines [9, 18, 19]. These results suggest that an intervention that increases patients' knowledge of treatments may ameliorate negative mood and the subjective severity of side effects.

### Negative Affectivity Perspective

Negative affect has been shown to play a significant role in self-reported physical symptoms [20]. A meta-analysis of 58 studies published since 1980 on the psychological consequences of receiving a diagnosis of cancer indicates that cancer patients were more depressed than the normal population, but did not have greater anxiety or distress [21]. Although the mean levels of depression, anxiety, and distress of cancer patients did not reach psychiatric cutoffs [21], global negative affect may be increased during cancer treatment and could be associated with the severity of side effects.

Indeed, research has demonstrated that self-reported health complaints and illnesses are associated with negative affectivity [20, 22, 23]. The association between negative affectivity and health complaints appears to be quite general, occurring with a broad range of self-reported physical problems, including chest and back pains, itchy or painful eyes, sinus congestion, cold hands or feet, toothaches, severe stomach pain or cramps, swollen joints, headaches, and nausea [20, 24].

The present study examined the relation between patients' self-reported side effect severity and their levels of negative affect as well as the efficacy of an informational intervention in ameliorating or preventing symptom development. Study hypotheses were derived from: (a) a self-regulation perspective (side effects would be less severe and affect would be less negative for patients who received an informational intervention compared to those who did not), and (b) a negative affectivity perspective (severity of self-reported side effects would be positively associated with increased negative affect).

## **Patients and Methods**

### Patients

Study criteria for inclusion were: receiving RT as curative treatment for localized prostate cancer as outpatients, having no previous or concurrent cancer diagnosis (except basal cell skin cancer), being able to speak and read English, having no history of mental illness or alcoholism, being capable of meeting daily basic needs independently (Karnofsky Performance status of at least 80%), and being 18 years of age or older. One hundred eighty-four males from eight cancer centers enrolled in the study from 1991 to 1997. Because of data management errors, e.g., improper randomization or lost data (12 patients), refusal to complete study questionnaires (6 patients), and incomplete data (14 patients), only 152 patients were fully evaluable. No differences in demographic, clinical, and study variables were found among the patients who did and did not complete the study.

The mean age of the sample of 152 was 70.8 years (range = 44 to 85 years). Most of the patients were: married (86%), retired (76%), Caucasian (96%), and had at least a high school education (88%). The distribution of disease stage was 13% with stage A, 66% with stage B, and 21% with stage C disease. Most of the patients (92%) did not receive hormone therapy. Thirty-four patients were still employed. Participants were randomly assigned to either the intervention group ( $N = 77$ ) or the comparison group ( $N = 75$ ), after being stratified by work status and whether or not they were receiving hormone treatment.

### Interventions

Patients in both the intervention and the comparison groups listened to brief tape-recorded messages in the clinic before their first and fifth radiation treatments. The lengths of the audio-only tapes were four- and eight-minutes long, respectively, for the two treatments. A member of the research staff stayed with each patient while the tape recordings were played.

The tape-recorded messages for the comparison group contained general and global information that was generally available to all radiation therapy patients, including resources

available to them in the treatment setting. The first message contained an explanation of the RT adapted from the pamphlet, "Radiation Therapy and You," and talked about different types of radiation treatments, the use of high-energy x-rays to destroyed cancer cells, and how the type and dose of RT was matched to the type, location and size of the tumor [26]. The second message described the services available at the treatment facility (e.g. pharmacy for prescriptions, social services, etc.), the roles of the staff (e.g., treatment nurse, physicist, social worker, receptionist, and physician) involved in the patient's treatment, as well as a listing of community services available in the area (support groups, transportation, etc.). The messages also included self-care instructions to help them control or lessen side effects. Clinic personnel answered all questions patients had concerning their treatments.

For the intervention group, the tapes were designed to deliver specific, descriptive, sensory messages regarding RT procedures and related information based on self-regulation theory, in addition to the same self-care instruction given to the comparison group. The information was developed from descriptive data collected from men undergoing RT for prostate cancer [10] and was tailored to match the standard practices of the RT facility of each participating institution. The first tape described the procedures that would be encountered during simulation, the clinical set-up, and what would occur at the first treatment. The second tape described experiences that would be encountered during the succeeding weeks of treatment. The messages focused on the physical and sensory experiences associated with a particular phase of the treatment (e.g., would hear a buzzing sound as the machine moved); environmental characteristics (e.g., the size of treatment room); and, finally, temporal characteristics (e.g., when specific side effects were most likely to occur).

### Measures

Severity of Side Effects. During the last week of treatment, patients rated the severity on a 5-point Likert scale (0 = not at all, 5 = extremely severe) of five potential side effects: diarrhea,

fatigue, skin changes and/or irritation in the treatment field, sleep disruption, and urinary problems [26, 27].

Negative Affect. The tension-anxiety, anger-hostility, and depression-dejection subscales from the Profile of Mood States (POMS) [28] were used to assess negative affect. The measure asks patients to indicate how much each of 36 adjectives described their feelings during the past week using a 5-point Likert scale (0 = not at all, 5 = extremely). An average score of the three negative emotions was calculated to create a composite level of negative affect. Cronbach's alpha for the three subscales ranged from .73 to .91 and was .92 for the composite score in this study.

Demographic and Clinical Variables. Patient's age, education, race, stage of disease, total number of treatments, and whether or not hormone therapy was received, were obtained from an interview by the research staff.

#### Procedure

Prior to beginning simulation, consenting patients were randomized and listened to the appropriate intervention tape. Patients filled out the POMS and provided demographic and clinical information at the second treatment (early-treatment phase: Time 1). Patients listened to the second tape at the fifth treatment. At the last treatment, patients were asked to fill out the POMS again and to complete the Severity of Side Effects questionnaire (late-treatment phase: Time 2) (Figure 1).

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Insert Figure 1 about here  
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## Results

There were no significant differences between the intervention and the comparison groups in age, disease stage, daily dose of radiation, and total number of radiation treatments, or field size. The means and SD's of study variables are reported in Table 1.

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Insert Table 1 about here  
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### The Effects of Information and Negative Affect on Severity of Side Effects

A variable reflecting the change-score in negative affect over the course of the treatments was calculated by entering the negative affect score at Time 1 in a linear regression equation predicting negative affect at Time 2 and saving the resulting residual score ( $\Delta$ POMS). Thus,  $\Delta$ POMS indicates the residual change in negative affect from the early-treatment phase to the end-of-treatment phase. Then, a multivariate analysis of variance was performed with  $\Delta$ POMS and the severity of the five side effects as dependent variables and group assignment (coded 1 for the intervention group and -1 for the comparison group) as the independent variable. As shown in the upper half of Table 2, group assignment contributed significantly to the severity of sleeping problems and was a marginally significant contributor to fatigue severity. Group assignment was not significantly related to the other side effects or change in negative affect. Subsequent t-tests analyses revealed that patients in the comparison group reported more sleeping problems,  $p < .03$ , and fatigue,  $p < .06$ , than those in the intervention group. Thus, hypothesis 1 was partially supported in that the informational intervention reduced self-



reported fatigue and sleeping problems but did not reduce negative affect or the three other side effects examined.

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Insert Table 2 about here  
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The hypothesis that change in negative affect would be related to side effect severity was tested by a multivariate analysis with change in negative affect ( $\Delta$ POMS) as an independent variable and the five side effects as dependent variables. The results, shown in the lower half of Table 2, indicate that the data fits the model well for diarrhea, fatigue, sleep problems, and urinary problems, but not for skin problems.

Next, a series of five hierarchical regression analyses, with the five side effects, respectively, as the dependent variable, were conducted in order to further examine: (a) the direction of the association between changes in negative affect and development of side effect severity, (b) whether the association came from the level of negative affect at the early-treatment phase (baseline) or that at the end-of-treatment phase controlling for the baseline level, and (c) whether the effects of negative affect remain when the group assignment effect was included. The negative affect score at the early-treatment phase was entered in a regression equation in the first step and the group contrast code and the negative affect score at Time 2 were entered at the second step, simultaneously.

Beta coefficients from the five analyses are reported in Table 3. The early phase negative affect score was not significantly related to side effect development in any of the analyses. Greater fatigue was associated with assignment to the comparison group,  $p < .052$ , and with an increase in negative affect,  $p < .02$ . Sleeping problems were also

associated with being in the comparison group,  $p < .02$ , and with an increase in negative affect,  $p < .001$ . Urinary problems and diarrhea were associated only with concurrent negative affect,  $ps < .002$ , while skin problems were not associated with any study variables. Thus, the prior significant findings relating to hypothesis 1 were affirmed, and hypothesis 2 was supported by four of the five analyses.

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Insert Table 3 about here  
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In summary, patients in the informational intervention group reported less severe fatigue and sleeping problems than those in the comparison group, and increased negative affect was positively associated with the severity of self-reported side effects, regardless of group assignment. However, skin problems were not associated with either group assignment or the change in negative affect.

## Discussion

Results from the present study suggest that a brief educational intervention based upon self-regulation theory is helpful in reducing fatigue and sleep problems resulting from RT for cancer. Patients who received the informational intervention containing detailed information concerning RT and potential side effects reported less severe fatigue and fewer sleep problems than patients who received only general information. The informational intervention was designed to provide concrete objective sensory information and reduce uncertainty about the impending experience. While the educational intervention was effective in ameliorating sleep problems and fatigue, no benefit vis-à-vis the control group was observed in the severity of diarrhea, urinary

problems, or skin problems. The informational intervention also failed to improve affect, a finding consistent with previous research [26].

We observed that the development of side effects, including fatigue and sleep problems, was associated with an increase in negative affect, but not with baseline negative affect. Prior literature on this relationship has been inconsistent, with some studies having found a positive relation between fatigue and depression [3, 29, 30], anxiety [31], and global negative affect [12, 32], while others have found no significant relation between fatigue or sleep disturbance and depression [1, 2]. None of these studies, however, examined the relationship between treatment-related side effects and changes in negative affect during the course of treatment. The findings in the present study indicate that the change in negative affect, not the level of negative affect at the early-treatment phase, plays a significant role in patient-reported side effect development. However, because of the correlational nature of our analyses, we cannot state whether side-effect development causes or results from an increase in negative affect.

Fatigue and sleep problems are generally considered to be multidimensional phenomena [31 – 33] and their severity may be attributable to patients' subjective evaluations. Thus, in addition to an educational intervention that provides concrete objective information about treatments and potential side effects, psychological interventions designed to reduce negative affect might also be helpful in relieving these problems. As in the case of fatigue and sleep problems, diarrhea and urinary problems were associated with an increased level of negative affect, but unlike fatigue and sleep problems, diarrhea and urinary problems were not benefited by the educational intervention. Skin problem severity was related to neither negative affect nor group

assignment. A possible explanation for these dissimilar findings is that skin problems caused by receiving RT are an objective physical experience, and, thus, psychological factors, such as information or negative mood do not affect them. Diarrhea and urinary problems may lie in the middle of a continuum of subjective versus objective side effects.

The results from the present study imply that psychological interventions may be more effective in ameliorating subjective than objective side effects of RT. Further studies are needed to determine the differential contribution of psychological factors to various side effects associated with RT. The underlying mechanisms of the informational intervention and negative affect were not clarified in the present study. Potential mechanisms include the possibility that the informational intervention increases patients' assurance about their treatments, which, in turn, reduces anxiety and results in patients experiencing their side effects as less severe [9]. Also, because increased negative affect is associated with rumination and hypervigilance of physical sensations, it is possible that this accounts for the positive correlation between increased negative affect and increased side-effect severity [22]. In addition, although patients were randomly assigned to either the intervention or control conditions, and there were no group differences in the daily dose of radiation or in the total number of radiation treatments, without baseline information about symptom severity, it is not clear if the group differences in symptom severity found in the present study result from the intervention or were present prior to randomization. These research questions need to be addressed in future studies.

A longitudinal approach is required in future work to explore the relation between side-effect severity and psychological factors during the course of treatment. For example, patients' physical conditions before treatment, the level of mood disturbance

during treatment, and their physical conditions and perception of the burden of treatment, have contributed to side-effect severity [12, 32]. A longitudinal design will also allow detection of any causal relationship between psychological adjustment and side-effect severity. Utilizing standardized scales/devices, such as wrist actigraphy [3] to assess fatigue and sleep disturbances and standardizing times for measuring side effects, are also required in future work.

### Conclusion

Side effects, particularly fatigue and sleep disturbance, following cancer treatment, have been found to play an important role in patients' quality of life, including work, social, and emotional adjustment [5, 34, 35]. The results of the present study indicate that specific side effects of radiation treatment for prostate cancer can be reduced by an informational intervention and are related to change in negative affect during the course of treatments. The current findings have implications for future studies of patients with cancer and suggest the need to explore the mechanisms by which cancer treatment-related side effects develop and to design intervention that target specific side effects and improve patients' quality of life.

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Table 1. Means and SD's of Study Variables

	Intervention Group		Comparison Group	
	Mean	SD	Mean	SD
POMS_1	.98	1.01	1.22	1.42
POMS_2	.96	.88	1.01	1.20
Diarrhea	1.68	1.40	1.60	1.51
Fatigue	1.76	1.35	2.17	1.30
Skin Problem	.81	1.20	.72	1.13
Sleeping Problem	.58	1.12	1.04	1.37
Urinary Problem	2.19	1.47	2.08	1.64

Note. POMS\_1 = negative affect score at the early-treatment phase;  
POMS\_2 = negative affect score at the end-of-treatment phase

Table 2. F ratios by Multivariate Analysis of Variance

	Side Effects					
	Diarrhea	Fatigue	Skin Problems	Sleeping	Urinary	$\Delta$ POMS
Group	.03	3.10+	.22	4.62*	.15	.10
R-square	.00	.02	.00	.03	.00	.00
<hr/>						
$\Delta$ POMS	12.12***	6.09*	.00	17.15***	6.97**	
R-square	.07	.04	.00	.10	.04	

+  $p < .10$       \*  $p < .05$       \*\*  $p < .01$       \*\*\*  $p < .001$

Note.  $\Delta$ POMS = residual change in negative affect scores at the end-of-treatment phase from the early-treatment phase;  
 Group = 1 for the intervention group; -1 for the comparison group

Table 3. Beta coefficients from Hierarchical Regression Analyses

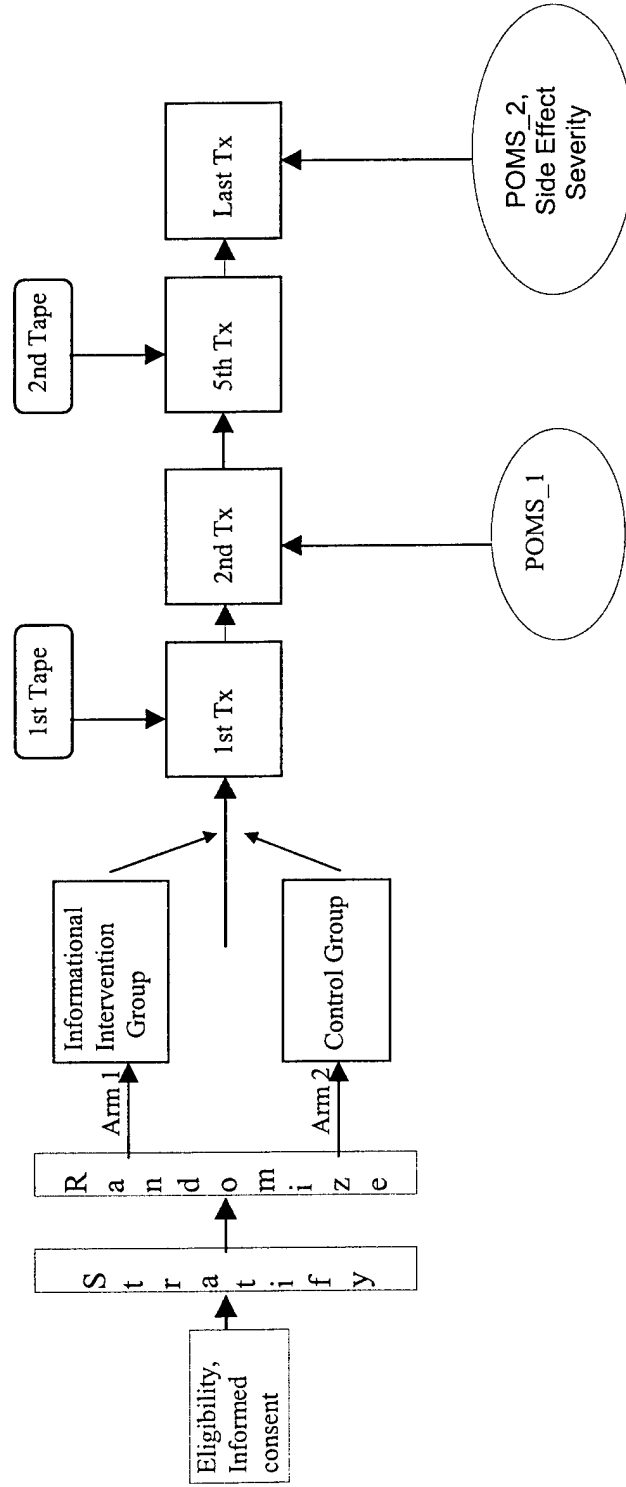
		Side Effects				
		Diarrhea	Fatigue	Skin Problems	Sleeping	Urinary
Step 1:						
	POMS_1	-.01	.05	-.02	.08	-.01
Step 2:						
	POMS_2	.34***	.22*	.06	.36***	.28***
	Group	.02	-.16*	.04	-.18*	.03

\*  $p < .05$       \*\*\*  $p < .001$

Note. POMS\_1 = negative affect score at the early-treatment phase;  
 Group = 1 for the intervention group; -1 for the comparison group;  
 POMS\_2 = negative affect score at the end-of-treatment phase

Figure Title

Figure 1. Study Schema



Note: Tx = treatment; POMS\_1 = Profile of Mood States measured at the early-treatment phase;  
 POMS\_2 = Profile of Mood States measured at the end-of-treatment phase

Self-Concept, Aspirations, and Well-Being  
in South Korea and the United States

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### Abstract

This study examined the similarities and differences between three dimensions which represent people's focus on the self vs. the other: individualistic vs. collectivistic nations, independent vs. interdependent self-concepts, and intrinsic vs. extrinsic aspirations. In samples of South Korean and U. S. college students, we found that each of these dimensions inter-related in expected ways, and that each was also independently associated with different aspects of participants' self-report of their own well-being (i.e., self-actualization, vitality, happiness, anxiety, and physical symptoms). We conclude that environmental circumstances and personality characteristics which focus on personal needs are more likely to provide experiences supportive of psychological well-being.

Key words: individualistic vs. collectivistic cultures, independent vs. interdependent self-concepts, intrinsic vs. extrinsic aspirations, well-being, cross-cultural study

## Self-Concept, Aspirations, and Well-Being in South Korea and the United States

Contemporary personality/social psychology contains several dimensional constructs representing the extent to which individuals focus on their own needs and rights versus their desires to fit their behavior and goals into the broader group. In this paper we focus on three such constructs, examining how they interrelate and how each is associated with personal well-being.

The first of the constructs, individualism vs. collectivism (Triandis, 1995), refers to a distinction between characteristics of the culture in which one lives. Individualistic nations, such as the economically developed, democratic Western nations, tend to suggest to their citizens that individual freedoms and rights are paramount. In contrast, collectivistic nations, such as the less economically developed Asian and Southern-hemispheric countries, send the message that social harmony and stability are most necessary for their citizens.

The second, highly related construct, is independent vs. interdependent self-concept (Markus & Kitayama, 1991). This dimension refers not to a cultural context, but rather to a set of beliefs people have about themselves. Specifically, it concerns a dimension capturing the distinction between conceiving of one's self as an individual, autonomous being versus viewing one's self as highly embedded in others, roles, and statuses in society. People with independent self-concepts typically believe their own rights and feelings outweigh those of the group, whereas those with interdependent self-concepts are particularly focused on the stability and harmonious functioning of the whole group (Markus & Kitayama, 1991; Singelis, 1994).



The third construct, intrinsic vs. extrinsic aspirations (Kasser & Ryan, 1993, 1996), distinguishes between strivings and aspirations likely to satisfy important psychological needs of the self (Ryan, 1995; Sheldon & Kasser, 1995, 1998) versus those more concerned with attaining social rewards and praise that signal high status within the group. Intrinsically oriented individuals are highly focused on goals for self-acceptance, affiliation, and community contribution, whereas extrinsically oriented individuals are more concerned with enhancing their wealth, image, or popularity.

As can be seen, each of these three constructs involves a dimension where at one end people are more likely to focus on their own individual psychological needs (individualistic cultures, independent self-concept, and intrinsic goals) whereas at the other end they are more concerned with making sure that their own behavior fits in with social norms (collectivistic cultures, interdependent self-concept, and extrinsic goals). On the face of it, the three conceptualizations have much in common, suggesting that they should be highly correlated with each other. Indeed, research and theory strongly suggest that living in an individualistic culture conduces towards an independent self-concept, while living in a collectivistic culture breeds interdependent self-concepts (Markus & Kitayama, 1991; Triandis, 1995). Further, some work shows differences between the types of values held by people with independent and interdependent self-concepts. For example, Oishi, Schimmack, Diener, and Suh (1998) examined the relations between independent and interdependent self-concepts and the values derived from Schwartz's (1994) theory of values in a sample of U.S. students. They found modest, but significant positive correlations between an independent self and measures of self-direction (which would be considered an intrinsic value), and positive correlations

between an interdependent self and the values of benevolence (an intrinsic value), tradition, and conformity (which are more similar to extrinsic values). While interesting, because this study was conducted in a highly individualistic nation, it is unclear what results might obtain in other contexts, particularly in collectivistic nations.

One purpose of the present study was therefore to examine how the three dimensions (culture, self-concept, and values) were associated with each other in both individualistic and collectivistic nations. We predicted that those subjects living in the U.S. would have a more independent self-concept, while subjects in South Korea would conceive of themselves more interdependently. We also explored the possibility that people's values would be differentially associated with their self-concepts. In particular, we expected to find that having an independent self-concept is associated with a stronger focus on intrinsic values, as both lead people to focus on their own inner needs. We expected a mixed pattern for the interdependent self-concept, however. That is, some of the intrinsic values, such as self-acceptance, appear somewhat at odds with this belief system, while others of the intrinsic values, such as community feeling and affiliation, may be more congruent with an interdependent self-concept.

The second purpose of the present study was to examine how these three dimensions independently relate to personal well-being. Past research shows a clear pattern of results for two of the dimensions, but a more mixed pattern for the third. Regarding individualism/collectivism, for example, Diener, Diener, and Diener (1995) demonstrated in a large cross-cultural study that people living in individualistic nations are typically happier than those living in collectivistic cultures, and that this result held even after controlling for a number of other important national characteristics (e.g.,

wealth, basic need satisfaction, etc.). Regarding the intrinsic/extrinsic distinction, research has demonstrated that U.S. adults and late adolescents highly oriented toward intrinsic aspirations evidence greater self-actualization, vitality, openness to experience, and general functioning, and lesser distress (e.g., depression and anxiety) than those oriented toward extrinsic aspirations (Carver & Baird, 1998; Kasser & Ryan, 1993, 1996, 2001; Sheldon & Kasser, 1995, 1998, 2001). Although these findings have been replicated in Germany (Schmuck, Kasser, & Ryan, 2000) and Russia (Ryan et al., 1999), this is the first study of which we are aware that has examined relationships between intrinsic/extrinsic values and well-being in an Asian culture.

While the well-being benefits of living in an individualistic nation and holding intrinsic values seem rather clear, work on the independent/interdependent self-concept is more mixed. Some research suggests that the independent self-concept is associated with lesser neuroticism than is the interdependent self-concept (Kwan, Bond, & Singelis, 1997). However, other studies suggest that individuals living in individualistic cultures who have interdependent self-concepts report more life satisfaction than those with independent self-concepts (Bettencourt & Dorr, 1997) and that, in collectivistic cultures, characteristics of interdependent self-concepts, such as valuing relationship harmony and social norms, can predict individuals' life satisfaction as strongly as does having an independent self-concept (Kwan et al., 1997; Suh, Diener, Oishi, & Triandis, 1998).

To our knowledge, no study has investigated how well-being is simultaneously associated with each of these three dimensions representing a focus on personal needs vs. others' opinions. Despite the fact that the three dimensions are similar to each other, we saw good reason to suspect that each may play an important role in predicting well-being.

One reason for this is that each dimension refers to a different level of personal experience: Individualism/collectivism refers largely to an environmental context, independence/interdependence refers to a belief about one's self, and intrinsic/extrinsic refers to the values and goals one is striving towards in life. Because these levels of experience, though related, do not entirely overlap, each of the dimensions could bear some weight in explaining people's well-being.

A second, more theoretical reason for this prediction is that the conceptualizations of the "self" from which each distinction derives are quite different. While the self of the individualism/collectivism and the independent/interdependent distinctions is primarily a "concept" inculcated from social experiences (Markus & Kitayama, 1991), the self of the intrinsic/extrinsic distinction is an experiencing center with inherent psychological needs which must be fulfilled in order for growth and optimal adjustment to occur (Ryan, 1995). Thus, the two distinctions may be tapping different parts of psychological functioning, one more "cognitive" and the other more "phenomenological" and motivational in nature.

In the current study we therefore expected to replicate past findings that living in an individualistic nation and placing a strong relative focus on intrinsic aspirations are associated with greater well-being, while living in a collectivistic nation and focusing on extrinsic aspirations are associated with lower well-being. We also suspected that an independent self-concept may yield more well-being benefits than would an interdependent self-concept, though recognize that the literature is mixed on this issue. Finally, we also examined whether people's home nation, self-concept, and aspirations, independently and/or interactively predict levels of personal well-being. Generally, we

expected each variable to typically account for its own share of variance in well-being, and that any interactions would merely be amplifications of the predicted main effects.

## Method

### Participants and Procedures

Participants included 537 students at U. S. (93 men and 122 women) and South Korean universities (149 men and 173 women) who completed a packet of questionnaires in small groups. Surveys were presented in subjects' native language, with South Korean scales translated by the first author, back-translated by a bilingual, then checked by the second author.

### Measures

Individualistic/Collectivistic Nation. We contrast-coded this variable so that Koreans received -1 and Americans received 1. Although there are scales to measure the internalization of individualistic and collectivistic values, other research has fruitfully applied parallel categorizations at a national rather than an individual level (e.g., Diener et al., 1995; Suh et al., 1998).

Independent and Interdependent Self-Concepts. The Independent and Interdependent Self-Concept Scale (Singelis, 1994) asks how much subjects to rate how much they agree or disagree with 24 statements on a 9-point Likert scale (1= strongly disagree, 9 = strongly agree). Average scores of 12 statements each for independent ( $\alpha = .65$ ) and interdependent ( $\alpha = .66$ ) self-concept were calculated. To represent the dimension of interest, the interdependent score was subtracted from the independent score to assess the relative independence/interdependence of subjects' self-concepts.

Intrinsic/Extrinsic Aspirations (Kasser & Ryan, 1993, 1996, 2001). Subjects were presented with 57 “goals they may have for the future” and rated the importance of each goal on a 1 (not at all) to 9 (extremely) scale. In line with past work, aspirations for self-acceptance, affiliation, community feeling and physical fitness were considered intrinsic while aspirations for financial success, social recognition, and attractiveness were considered extrinsic. Coefficients in the present study were .67 for intrinsic goals and .79 for extrinsic goals. Summary extrinsic scores were subtracted from summary intrinsic scores to compute a relative intrinsic/extrinsic orientation variable.

Well-being. Six variables assessed individuals’ levels of well-being. On 9-point Likert scales, subjects completed the 15-item Jones and Crandall (1986) measure of self-actualization ( $\alpha = .64$ ), the seven-item vitality measure (Ryan & Frederick, 1997,  $\alpha = .86$ ), six items measuring anxiety (Derogatis, Lipman, Rickels, Uhlenhuth, & Covi, 1974,  $\alpha = .84$ ), and ten items reporting experience of physical complaints (Emmons, 1991;  $\alpha = .79$ ). Finally, subjects reported the percentage of time they are generally happy and unhappy (Fordyce, 1988).

## Results

### Tests for Measurement Comparability and Sociocultural Differences on Constructs.

First, we sought to demonstrate the reliability and comparability of study constructs across the two cultures by applying the multiple-group means comparison procedure (Little, 1997), in addition to the variance-covariance information of standard structural equation modeling analyses, using Amos 4.0 (Arbuckle & Wothke, 1999). Thus the following questions can be answered directly: (a) whether or not the same underlying dimension is measured with little or no bias across multiple groups (viz.,

measurement equivalence of the constructs) and (b) whether there are similarities and differences across groups on the error free means of the latent constructs (viz., construct comparability). The following three model fit indices were used in the present study: the root mean squared error of approximation (RMSEA), the normed fit index (NFI), and comparative fit index (CFI). Values reflecting adequate fits of a specified model to the data were set at  $< .08$  for the RMSEA measure (Browne & Cudeck, 1993) and  $> .9$  for the NFI and CFI (Marsh, Balla, & McDonald, 1988). The self-concept construct was measured by two indicators: independent (reference) and interdependent self-concepts. The aspiration construct was measured by two indicators: intrinsic (reference) and extrinsic aspirations. Finally, well-being was measured by six indicators: self-actualization (reference), vitality, anxiety, physical symptoms, percentage of time happy, and percentage of time unhappy.

Showing good support for cultural comparability, the measurement model for each construct (self-concepts, aspirations, and well-being) without equal constraints fit satisfactorily ( $.00 < \text{RMSEA's} < .04$ ;  $.99 < \text{NFI's} < 1.00$ ;  $.99 < \text{CFI's} < 1.00$ ). When both factor loadings and intercepts in measurement models were constrained to be equal between two nations, each construct was again found to be comparable ( $.03 < \text{RMSEA's} < .12$ ;  $.95 < \text{NFI's} < 1.00$ ;  $.96 < \text{CFI's} < 1.00$ ). Thus, we can be confident that our primary study variables were both reliably and equivalently measured across cultures.

Because construct comparability was tenable, equality of the latent means was tested between the two nations (Little, 1997). All corresponding parameters (viz., factor loadings, intercepts, and error variances of observed variables) were freed for the Korean sample and set to be the same for the U.S. sample. The estimated latent factor means

were fixed to 0 for the Korean sample and freed for the U.S. sample, thus a given construct's mean could be identified and estimated as a relative difference from the reference point estimated in the Korean sample (Jöreskog & Sörbom, 1996; McArdle & McDonald, 1984).

The results showed that the fit of the model was satisfactory but significantly different from the model without equal constraint in latent means: for self-concept,  $\chi_{\text{diff}}^2(11) = 96.10, p < .001$ ; for aspirations,  $\chi_{\text{diff}}^2(15) = 99.64, p < .001$ ; and for well-being,  $\chi_{\text{diff}}^2(11) = 52.91, p < .001$ . Using the Korean sample as a reference group of mean equal zero, differences in construct means were .85, .31, and .48,  $ps < .001$ , for self-concept, aspirations, and well-being, respectively. What this means is that the results indicated that two cultures did differ in their endorsement of the personality variables. In line with past research, the U.S. sample was higher than the Korean sample in independent self-concept and in well-being; the U.S. sample was also higher in intrinsic aspirations, as predicted but not previously demonstrated.

#### Independent/Interdependent Self-Concepts and Intrinsic/Extrinsic Aspirations.

Next, we examined relationships between self-concepts and aspirations, to determine whether our results conceptually replicated Oishi et al. (1998) when tested in both individualistic and collectivistic cultures. Supporting their results and our hypothesis, having an independent self-concept was positively associated with students' focus on intrinsic aspirations ( $r = .16$  in Korea;  $r = .17$  in U.S.,  $ps < .05$ ) and negatively correlated with their focus on extrinsic aspirations ( $r = -.11$  in Korea;  $r = -.14$  in U.S.,  $ps < .05$ ). As expected, the directions of relationship between interdependent self-concept and intrinsic versus extrinsic aspirations were more mixed, however. The interdependent



self-concept was negatively associated with the summary intrinsic score ( $r = -.12$  in Korea,  $p < .05$ ;  $r = -.08$  in U.S., ns) and was not significantly associated with the summary extrinsic score ( $r = .05$ , in Korea;  $r = .01$  in U. S., ns). Supplementary analyses with individual intrinsic and extrinsic subscales revealed that the interdependent self-concept was associated with greater community feeling ( $r = .11$  in Korea,  $p < .05$ ;  $r = .12$  in U. S.,  $p < .10$ ) and less focus on self-acceptance ( $r = -.24$  in Korea;  $r = -.19$  in U. S.,  $ps < .01$ ) among intrinsic subscales, and was associated with a greater focus on social recognition ( $r = .16$  in Korea;  $r = .20$  in U. S.,  $ps < .01$ ) and less focus on financial success ( $r = -.10$  in Korea,  $p < .10$ ;  $r = -.14$  in U. S.,  $p < .05$ ) among extrinsic subscales. These associations were not different between the two nations.

#### Predicting Well-Being.

We then examined how the three dimensions of interest predicted subjects' well-being. As reported above, the measurement models for the endogenous latent variables of self-concepts and aspirations fit satisfactorily, which means each latent variable can be accurately operationalized by the relative contribution of the observed variables. Thus, we created for subsequent analyses two new variables: a relative independent to interdependent self-concept variable, and a relative intrinsic to extrinsic aspiration variable.

The top third of Table 1 presents beta weights resulting from simultaneous regression analyses for the combined U.S. and South Korean sample, in which each of the six well-being indicators was regressed onto the contrast-coded nation variable, the relative independent to interdependent self-concept variable, and the relative intrinsic to extrinsic aspiration variable. As can be seen, U.S. students reported higher self-

actualization, vitality, and happiness than did Korean students. Further, the relative independent to interdependent self-concept variable was associated with higher self-actualization, vitality, and happiness, and with less unhappiness and anxiety. Finally, the relative intrinsic to extrinsic aspiration measure was associated with higher self-actualization, and with less anxiety and physical symptoms.

To examine whether the predictors of well-being differed by individuals' national context, we re-conducted these regression analyses separately in the two countries. Results are reported in the middle and bottom thirds of Table 1. Within samples from both countries, a relative independent self-concept was associated with higher self-actualization, vitality, and happiness; however, only in Korea did the relative independent self-concept predict less unhappiness and only in the U.S. did the relative independent self-concept predict low anxiety. Results across the two cultures were almost identical for the relationships between well-being and the relative intrinsic/extrinsic aspiration measure, such that a strong focus on intrinsic relative to extrinsic aspirations was associated with greater well-being. Thus, regardless of whether they live in an individualistic or a collectivistic nation, the current results suggest that people's well-being benefits from the belief that they are autonomous beings and from a focus on goals likely to satisfy one's needs.

Finally, we examined potential two-way interactions between aspirations and self-concept, and three-way interactions with the additional variable of nation, in the prediction of well-being, using a hierarchical regression format. Only one significant two-way interaction was detected: the negative associations between extrinsic aspirations and higher anxiety were amplified for individuals relatively high in interdependent self-

concept ( $\beta = -.13, p < .02$ ). In addition, only one significant three-way interaction occurred. For the Korean students, intrinsic aspirations were more highly associated with increased self-actualization when individuals were high in independent self-concept. For the U. S. students, intrinsic aspirations were especially associated with higher self-actualization when the individual had a relatively strong interdependent self-concept ( $\beta = -.13, p < .02$ ). Interpretation of these two interactions should be treated cautiously, as they are quite possibly due to chance given the large number of analyses conducted.

### Discussion

The present study expands on previous research by examining several hypotheses associated with national context, individual self-concept, personal goals, and subjective well-being. First, we expanded on the work of Oishi et al. (1998) by examining how self-concept and values relate to each other within both individualistic and collectivistic nations. As expected, people with an independent self-concept were more likely to place a strong value on intrinsically oriented goals and less likely to be focused on extrinsically oriented goals. This is to be expected, given that an independent self-concept, with its concern for autonomous regulation, might orient people towards goals congruent with their own psychological needs and away from goals focused on status and others' opinions. Results for the interdependent self-concept were rather more complex, as correlations indicated more self-concept/value relational specificity. With regards to intrinsic values, interdependent people were more likely to value community feeling and less concerned with self-acceptance; for extrinsic values, interdependent people were more concerned with social recognition and less focused on financial success. In both cases, it seems as though an interdependent self-concept leads people to value more

socially oriented values (i.e., community feeling and social recognition) and to be less concerned with more personally-oriented values (i.e., self-acceptance and financial success). These results provide an important extension of Oishi et al.'s work to a collectivistic nation.

A more unique contribution of this work was our examination of how cultural context, self-concept, and values independently relate to personal well-being. The results supported our hypotheses that living in an individualistic nation, believing that one is an autonomous, independent individual, and striving for intrinsic aspirations associated with psychological needs are associated with greater well-being. In contrast, results suggested that living in a collectivistic nation, conceiving of oneself as highly embedded in social roles and statuses, and pursuing aspirations designed to obtain rewards and praise are associated with lower well-being. As expected, these results were essentially parallel in samples of college students drawn from both the highly individualistic nation of the United States and the more collectivistic culture of South Korea. These results are consistent with past work demonstrating beneficial relationships between well-being and individualistic nations (Diener et al, 1995), independent self-concepts (Oishi, Diener, Lucas, & Suh, 1999), and intrinsic aspirations (Kasser & Ryan, 1996), conflict with some past work demonstrating that interdependent self-concepts relate positively to well-being and life satisfaction in collectivistic nations (Kwan et al., 1997; Suh et al., 1998). Thus, our research adds to the growing, but somewhat contradictory, literature associating an independent self-concept with well-being, and confirms previous work on the well-being benefits of living in an individualistic culture and pursuing intrinsic rather than extrinsic goals.

More importantly, the results of this study demonstrate for the first time that these three dimensions, all focused on one's needs vs. others' desires, bear unique, independent relationships to well-being. That is, although individualism/collectivism, independent/interdependent self-concept, and intrinsic/extrinsic values all focus on similar issues, each has its unique role to play in understanding well-being. This supports the idea, mentioned in the introduction, that each dimension is tapping a somewhat different aspect of experience relevant to well-being. Individualism/collectivism likely concerns the affordances of one's environment in terms of pursuing one's desires. Independent/interdependent self-concept probably involves more cognitive issues, as it concerns the beliefs one has about one's identity and personhood. Intrinsic/extrinsic values may tap a more motivational aspect of experience, particularly concerning how one's strivings and goals relate to the satisfaction of psychological needs.

Why should this conglomeration of environmental circumstances, beliefs about the self, and values and goals lead people to experience greater well-being and less distress? Our sense is that the best answer derives from the concept of needs. Needs are "psychological nutriments" (Ryan, 1995) which must be satisfied in order that individuals can grow, thrive, and feel good about themselves (Sheldon, Ryan, & Reis, 1996; see also Maslow, 1954). Living in an individualistic culture provides an environment which encourages people to focus on their own needs and to determine means of satisfying them (Triandis, 1995); having an independent self-concept leads people to believe that their own needs are of large importance, and thus to set up their identity around them (Markus & Kitayama, 1991); and pursuing intrinsic aspirations leads people to be more likely to have experiences which might satisfy their needs (Kasser, in press; Kim, Deci, &

Zuckerman, in press). In sum, people are more likely to be able to satisfy their psychological needs in such contexts and with such beliefs and goals, and thus to reap the benefit of increased well-being.

In contrast, collectivistic nations, interdependent self-concepts, and extrinsic values are more focused on the “other” and on making sure that one’s behaviors, expressions, and desires fit into what is acceptable to the whole group. Such an external focus may lead people to attend less to their psychological needs, and thus to have more frequent experiences of contingent evaluation in which they feel their worth is on the line, experiences which are rarely pleasant (see Deci & Ryan, 1991; Rogers, 1961). In other words, such environments, self-concepts, and goals are more lacking in providing psychological nutriments, thus causing potentially less need-satisfaction and lowered well-being.

These conclusions must of course be tempered by several limitations to the current study. First, our use of college students as participants calls into question the generalizability of our sample; this might be especially worrisome in the case of the South Korean sample, in which college students are probably more independent in their self-concept than, for example, rural farmers. Second, all data are self-report, leaving open the possibility that response biases or shared method variance may be primarily responsible for the results. Third, all data are cross-sectional and correlational, thus making the results causally ambiguous. That is, it is unclear whether self-concepts and goals lead to well-being, happier people form independent self-concepts and pursue intrinsic goals, or whether some third variable may be operating which explains the relationships. Fourth, although measurement comparability between cultures was

demonstrated and established scales were used in this study, it should not be overlooked that internal consistencies of some scales were somewhat low (less than .70); this may potentially have weakened reported results. Fifth, the amount of variance accounted for in regression equations was by no means large, suggesting that a variety of other factors need to be assessed in order to provide a fuller understanding of well-being. Sixth, it would be interesting in future studies to measure participants' levels of individualistic/collectivistic values rather than use a dummy code for nation, as individuals certainly experience and internalize this environmental dimension differently within the same nation, and as there are many differences between the nations we sampled besides their standing on this variable.

A final limitation concerns our use of well-being as the primary outcome variable of this study. Such a strategy runs the risk of leading people to conclude that individualistic nations, independent self-concepts, and intrinsic aspirations are "better" than collectivistic nations, interdependent self-concepts, and extrinsic aspirations. The idea that "happiness" is the most important aim for humans is itself a value judgment, one especially consistent with individualism, independence, and intrinsic values. The aims better supported by collectivistic nations and interdependent self-concepts, such as relationship harmony and social stability, or represented in extrinsic aspirations, such as economic progress, can certainly be conceived of as equally or more "valuable" than personal happiness and well-being. Further, we remind the reader that all is not rosy for independent self-concepts and living in an individualistic nation, which are associated with higher suicide and divorce rates and substantial ecological degradation (Triandis,

1995). Future studies are thus called for to examine a broader range of variables which will help researchers better understand and untangle these complex issues.



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Table 1. Beta Regression Coefficients of Well-being Measures

	Self-Actualization	Vitality	Happiness	Unhappiness	Anxiety	Physical Symptoms
<u>Whole Sample</u>						
R-Independent	.24***	.17***	.18***	-.13**	-.11*	-.02
R-Intrinsic	.32***	.05	-.03	-.04	-.12**	-.17***
Nation (Korea= -1; U.S.=1)	.34***	.23***	.21***	-.02	-.06	-.01
R-square	.36***	.10***	.08***	.02	.04***	.03***
<u>Korean Sample</u>						
R-Independent	.27***	.16**	.19***	-.15**	-.04	.04
R-Intrinsic	.36***	.03	-.06	.01	-.11+	-.18**
R-square	.24***	.03*	.04**	.03*	.02	.03*
<u>U. S. Sample</u>						
R-Independent	.25***	.20**	.17*	-.10	-.22***	-.12+
R-Intrinsic	.33***	.07	.00	-.11	-.12+	-.15*
R-square	.22***	.05*	.04*	.03	.07***	.04*

+  $p < .10$     \*  $p < .05$     \*\*  $p < .01$     \*\*\*  $p < .001$

Note. R-Independent = Relative independent to interdependent self-concept;

R-Intrinsic = Relative intrinsic to extrinsic aspirations

The Moderating Effects of Coping on the Psychological Impact of  
Having Family Histories of Breast Cancer

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### Abstract

Healthy women with family histories of breast cancer (FH+) have been repeatedly found to have higher levels of cancer-specific distress compared to women who have not experienced cancer in their families (FH-). Among FH+ women, however, considerable variability in both cancer-specific and general distress has been noted, with scores ranging from clinical to normal levels. Individual differences in coping strategies were examined in the present study as a likely moderator of the relationship between the stress of having family histories of breast cancer and psychological outcomes. One hundred and sixteen healthy women (47 FH+ and 69 FH-) participated. Results revealed that greater utilization of emotion-focused coping (Ways of Coping Questionnaire) was associated with higher levels of breast cancer-specific distress among FH+ women, but not among FH- women. This interaction was not seen for measures of negative or positive affect, although use of emotion-focused coping predicted higher levels of negative affect across both FH groups. Supporting the distinction between the two coping strategies, use of problem-focused coping was not associated with cancer specific distress or negative affect, but was associated with higher levels of positive affect, across both FH groups. These results provide the first evidence in the literature that emotion-focused coping may have negative consequences for women with family histories of breast cancer, and suggest that individualized coping training programs targeting this coping strategy may prove useful for these women.

Key words: family histories of breast cancer, coping, psychological distress, positive affect

Breast cancer is the second most common cancer and the second leading cause of cancer death among American women (1). It is estimated that in 2001, approximately 192,200 women in the United States were diagnosed with breast cancer. The lifetime risk of breast cancer for women in the U.S. is 1 in 8 (1) and is even higher among women with family histories of the disease, which is the strongest predictor of a woman's lifetime risk of developing breast cancer (2). Although mortality rates have declined significantly in recent years due to both earlier detection and improved treatment, treatment can be highly aversive and is not always successful. Indeed, it is estimated that approximately 40,200 American women died of breast cancer in 2001 (1).

Accumulating evidence suggests that having experienced breast cancer in a close relative (e.g., their mother) is a significant life stressor for healthy women (see for review, 3). Healthy women with family histories of breast cancer have been found to have higher levels of cancer-specific distress than women without such histories (4-6). Surveys of women with family histories of breast cancer have also consistently revealed high levels of cancer-specific distress. For example, Lerman and colleagues (7) found that 53% of their sample of first degree relatives of breast cancer patients experienced intrusive thoughts about breast cancer, with 30% of these women indicating that their breast cancer worries interfered with their daily lives. More recently, Neise and colleagues (8) found that nearly a third of their sample of women with family histories of breast cancer experienced intense cancer-specific psychological strain. Although less consistent from study to study, higher levels of general distress have also been observed among women with family histories of breast cancer (4-7, 9-14). Kash and colleagues (13) found that 27% of women with histories of breast cancer in their families reported

levels of distress that were at least one standard deviation above standardized population means on the Brief Symptom Index (BSI: 15).

The findings from the above studies while generally indicating that women with family histories of breast cancer have higher levels of distress, also revealed wide variability in both cancer specific and general distress levels among these women, underscoring the need to examine factors that may account for individual differences in distress levels. Although the transactional theory of coping has compellingly established that individuals' coping strategies moderate the impact of a variety of stressors on emotional distress (see reviews, 16, 17), little attention has been paid to the role of coping among women who have experienced cancer in their families.

Coping has been defined as "cognitive and behavioral efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of the person" (18, p. 141). The transactional theory (Lazarus & Folkman, 1984) has conceptualized two general coping dimensions. Emotion-focused coping refers to the efforts to regulate emotional distress, while problem-focused coping refers to efforts to manage, or alter, the troubled person-environment relationship. Although coping is an initial effort to minimize the negative impact of stress, the consequences of utilizing certain coping strategies do not always meet this purpose (see, 19, 20). Indeed, among patients with breast cancer (21-23) and among family members of terminally ill cancer patients (24), the use of emotion-focused coping has been related to higher distress. On the other hand, the use of problem-focused coping has been associated with fewer anxiety and depression symptoms among patients with breast cancer (25).

Coping theory also posits that positive affect can occur even in the context of stress as a result of coping processes generating and sustaining positive affect (18). However, only recently have researchers started to pay attention to positive outcomes of coping with various stressors (e.g., 26-29). As yet there have been no studies examining the relationship between having family histories of breast cancer and positive outcomes of coping.

To date, only one study (14) has compared women with family histories of breast cancer to women without such family histories to explore differences in utilization of such coping strategies. Using the Ways of Coping Questionnaire, Wellisch and colleagues (14) found that women with family histories were quite similar in their primary utilization of problem-focused coping compared to women without such family histories. However, this study did not examine if the use of certain coping strategies was associated with specific psychological outcomes (e.g., cancer-specific or general distress) or if coping strategies moderated the psychological impact of having experienced breast cancer in the family.

The present study examined if individual differences in utilization of coping strategies moderate the impact of having family histories of breast cancer on psychological distress (cancer-specific and general). Specifically, utilization of emotion-focused coping was hypothesized to be associated with higher levels of cancer-specific distress and general negative affect, which would be more prominent among women with family histories of breast cancer compared with women without such histories. Utilization of problem-focused coping was hypothesized to be associated with lower

levels of cancer-specific distress and negative affect. In addition to examining the impact of coping on psychological distress, we also explored its influence on positive affect.

## Method

### Participants

One hundred and sixteen women, with first-degree relatives with breast cancer ( $N = 47$ ) and without such relatives ( $N = 69$ ), were included in the present study, which is part of a larger longitudinal investigation of women with family histories of breast cancer (30). Participants were recruited by advertisements placed in three medical centers in New York City. The mean age of the sample was 43 years (range 25 to 69;  $SD = 10.6$ ). Most participants were ethnic minorities (77% African-American, 10% Hispanic, 1% Asian). Over a third of the participants had completed college and a third of the participants were married. Among women with family histories of breast cancer, average time since the diagnosis of breast cancer of the first-degree relatives was 23 years (range 3 to 54 years;  $SD = 12.9$ ).

### Procedures

Participants provided written informed consent prior to participating in this study. Questionnaires were completed in the presence of an investigator who was available to clarify any items. To reduce burden at study assessment visits, participants were permitted to complete the demographic portion of the questionnaire and the coping measure at home and return it later. Questionnaire assessments of psychological outcome data were obtained on three separate occasions approximately one month apart. As no main effects or interaction effects with assessment time were significant, each measure was averaged across the three assessments to provide more reliable measure of these

constructs. The average scores were then used in the analyses. Participants were offered \$20 plus the cost of public transportation to and from study assessments.

### Measures

Demographics. Participants completed standard questions assessing demographics including age, education, ethnicity, and income.

Family History of Breast Cancer. Participants completed a standardized questionnaire assessing family histories of cancer (30). The questionnaire included items asking whether or not the participant's first-degree relatives (e.g., mother, sibling, or daughter) had been diagnosed with breast cancer. In addition, participants reported how likely they believed they were to develop breast cancer sometime during their lives, on a scale of 0% (not at all likely) to 100% (extremely likely) (5, 6, 31).

Coping. Participants indicated the extent to which they had used different coping styles in response to stressful events, using the Ways of Coping Questionnaire (WCQ: 32), in a 4-point Likert-style format (0 = not used, 3 = used a great deal). To reduce participant burden, thirty-one items from eight subscales (3 to 4 items per subscale), which had high factor loadings (33), were included in the present study (the 31 items are available from the author upon request).

Following Tennen and Herzberger's (34) recommendation, factor analysis was conducted for the data in our sample to determine types of coping strategies (see also, 35). Factor analysis with varimax rotation extracted nine factors with eigenvalues greater than 1 (65.2% of the variance was explained). Higher-order factor analysis with nine factor scores using varimax rotation extracted two higher-order factors with eigenvalues greater than 1 (44% of the variance was explained). The first higher-order factor

(eigenvalue = 2.07) includes 16 items indicating efforts to regulate emotional distress (e.g., “I tried to keep my feelings to myself.” “Wished that the situation would go away or somehow be over with.” “I avoided being with people in general.”). This factor was labeled emotion-focused coping. The second higher-order factor (eigenvalue = 1.89) includes 15 items indicating efforts to manage or alter the problem (e.g., “Just concentrated on what you had to do next.” “I changed something so things would turn out all right.” “Talked to someone who could do something concrete about the problem.”). This factor was labeled problem-focused coping. Composite scores for each of these two coping strategies were created by averaging relevant items and were used in the subsequent analyses as measures of individual differences in coping strategies. Both coping strategy composites had good internal consistency ( $\alpha = .80, .79$  for emotion-focused and problem-focused coping, respectively).

Breast Cancer-Specific Distress. Breast cancer-specific distress was measured using the 15-item Impact of Event Scale (IES; 36), replacing “event” with “breast cancer.” Responses on the scale were for the past three weeks, using a 4-point Likert-style scale (0 = not at all, 1 = rarely, 3 = sometimes, and 5 = often). The IES has two subscales: Intrusion, which assesses intrusive thoughts and feelings (7 items) and Avoidance, which assesses avoidance of certain thoughts, feelings, or situations (8 items). Both subscales (5-7, 13, 30) and the total composite score (IES; 37) have been widely used to assess the level of cancer-specific distress among individuals with family histories of cancer. In the present study, the two subscales were highly and significantly correlated ( $r = .80, p < .001$ ) and were therefore summed to make a total composite score on the IES (37). The IES measure had good internal consistency ( $\alpha = .91$ ).

Negative Affect, Positive Affect, and Mood. Negative affect and positive affect were assessed using a Negative Affect (7 items) and Positive Affect (7 items) Scale (NAPAS) derived from the Profile of Mood States (38, 39). Negative affect and positive affect scores of the NAPAS had good internal consistency in the present study ( $\alpha = .94, .89$ , for negative affect and positive affect, respectively). To provide a broader indication of participants' moods on the day of assessment, items required to complete the short version of the Profile of Mood States (SV-POMS: 40) were also administered. The validity of the SV-POMS scale (37 items) has been documented (40, 41) and each subscale had good internal consistency in the present study ( $.77 < \alpha's < .94$ ). Participants rated all items for the day of assessment using a 5-point Likert-style scale (0 = not at all, 4 = extremely).

## Results

Before testing the primary study question, possible differences in study variables between the group of women with family histories of breast cancer (FH+) and the group without such family histories (FH-) were examined for possible inclusion in study analyses as covariates. Among demographic variables, there was a trend for a group difference in income (70% FH+ had an income of greater than \$20,000, 54% for FH-,  $\chi^2 = 3.22, p < .06$ ). However there were no group differences in age ( $M = 44.41$  years for FH+, 41.48 for FH-), education (85% completed high school for FH+, 88% for FH-), and proportion of African American participants (77% for FH+, 74% for FH-). There was also a significant group difference in the level of perceived risk of developing breast cancer (49.57% for FH+, 37.0% for FH-,  $t = 2.53, p < .05$ ). Therefore, income and perceived risk were included as covariates in subsequent analyses.



Univariate analyses to test group differences in coping strategies and psychological outcomes revealed that women in the FH+ group utilized both emotion-focused and problem-focused coping strategies less frequently than women in the FH- group (Table 1). There were no significant FH group differences in psychological outcomes.

Hierarchical regression analyses were conducted on each psychological outcome measure to examine the hypothesized moderating effects of coping in the relationship between having family histories of breast cancer and psychological outcomes. In the first step, the two covariates (i.e., income and perceived risk) were entered. A dummy coding for family history group (1 for women with family histories of breast cancer; 0 for women without family histories of breast cancer) and two scores of coping strategies (i.e., emotion-focused and problem-focused) were entered in the second step to examine the main effects of these variables. In the third step, interaction terms (two-way and three-way) were entered into the equation.

#### Effects of FH and Coping on Breast Cancer-Specific Distress

As shown in the first column of Table 2, the hypothesized two-way interaction effect between family history group and emotion-focused coping was significant. The source of this interaction was determined with follow-up regression analyses, which revealed a significant positive association between emotion-focused coping and breast cancer-specific distress for the FH+ group ( $\beta = .83, p < .05$ ), but not for the FH- group ( $\beta = -.04, ns$ ) (Figure 1).

The main effects of family history group and emotion-focused coping were also significant. No other main or interaction effects were significant.

### Effects of FH and Coping on Negative Affect

As shown in the second column of Table 2, the hypothesized interaction effect between family history group and emotion-focused coping was not significant. However, a main effect of emotion-focused coping was significant, indicating a positive association between utilization of emotion-focused coping strategy and general distress. No other main or interaction effects were significant.

### Effects of FH and Coping on Positive Affect

As shown in the third column of Table 2, the hypothesized interaction effect between family history group and problem-focused coping was not significant. However, the main effect of problem-focused coping was significant, indicating a positive association between utilization of problem-focused coping strategy and positive affect. No other main or interaction effects were significant.

### Effects of FH and Coping on Mood

To further confirm the relations between coping and affect, we conducted supplementary analyses using the same hierarchical regression approaches on the six POMS subscales (tension, depression, anger, fatigue, confusion, and vigor). Significant negative relations with emotion-focused coping were found for the POMS tension, depression, anger, and confusion subscales,  $p_s < .05$ , but not with fatigue. A significant positive relation between problem-focused coping and the POMS vigor subscale was also found,  $p < .05$ .

## Discussion

The main purpose of this study was to examine whether coping strategies moderated the effect of having family histories of breast cancer on psychological

outcomes. Findings in the present study revealed that the impact of emotion-focused coping strategy on the psychological outcomes was different by family history group, supporting the moderating effect model of coping (42) for this stressor. Specifically, higher utilization of emotion-focused coping was found to be associated with a higher level of cancer-specific distress among healthy women with histories of breast cancer in their first-degree relatives. A similar pattern was not found among women without such family histories. Emotion-focused coping in the present study included coping approaches such as emotional suppression or denial (e.g., "I tried to keep my feelings to myself." "I tried to forget the whole thing." "I went on as if nothing had happened."). The findings of the present study suggest that use of such coping approaches may aggravate the degree to which individuals who have experienced breast cancer in their close family members have intrusive thoughts and feelings about breast cancer.

Unlike cancer-specific distress, the relations between emotion-focused coping and negative affect did not differ between the two family history groups. Rather, greater use of emotion-focused coping was associated with higher levels of negative affect across both groups. This result suggests that in the context of daily life stressors, use of emotion focused coping results in higher levels of distress. Such negative effects of emotion-focused coping have been reported in previous studies of individuals confronting a variety of stressful events (e.g., 21, 22, 24, 25).

With regard to problem-focused coping, the present study found no support for the hypothesized differential impact by FH group on either cancer-specific distress or negative affect. However, a greater use of problem-focused coping was associated with a higher level of positive affect across the FH groups. Problem-focused coping in the

present study included coping strategies such as planning or engaging in behaviors to solve the problem (e.g., “Made a plan of action and followed it.” “Just concentrated on what you had to do next – the next step.”). Such problem-focused coping strategies appear to concentrate on what the individuals would do in the future and the associated action plan. The results of the present study suggest that in the context of daily life stressors, use of such problem-focused approaches results in higher levels of positive affect. These results are consistent with previous studies of individuals confronting various life stressors, which have shown strong positive associations between the use of problem-focused coping and positive affect (e.g., 26, 27, 29). Together these findings support an emerging view that this type of coping is highly predictive of positive affect (16).

An unexpected finding in the present study was that there were differences in utilization of coping strategies by family history group. Unlike the findings in Wellisch and colleagues’ study (14), women with family histories of breast cancer in the present study utilized both emotion- and problem-focused coping strategies less frequently than women without such histories. The explanation for these discrepant results is not clear. One possibility is ethnic differences between the two study samples. The participants in Wellisch and colleagues’ study were all Caucasian, while the sample in the present study was primarily made up of ethnic minorities. Differences in coping with stress by different ethnic groups among young adult community samples have been found (e.g., 43). For example, Asian Americans tend to use more strategies of accepting responsibility, religious coping, distancing, and escape-avoidance than the Caucasian Americans did. Further investigations are clearly needed to determine the factors that

account for the reduced use of coping strategies by women with family histories of breast cancer.

Limitations of the present study should not be overlooked. First, it has been suggested that the relationship between coping and affect may be reciprocal (17). For example, utilization of certain coping strategies, such as emotion-focused coping, may lead to more distress in the presence of stressor, or alternatively, distressed individuals may be more likely to engage in such coping strategy. Although cross sectional studies are common in the coping literature, prospective longitudinal studies and randomized theory-based intervention studies are clearly needed to confirm the directionality of putative causal relationships between coping and affect (17).

Second, an individual's coping strategy can be different in different situations, when dealing with different type of stressors, or depending on perceived controllability over outcomes (e.g., 44). For example, an individual's coping strategy to deal with the stressor of having a history of breast cancer in the family may be different from what they use to deal with other stressors. Future studies that assess coping strategies specifically used by these women for dealing with their family history of breast cancer may help to further elucidate the role of coping in adjustment to this stressor.

Third, although the present findings suggest emotion-focused coping is maladaptive for women having family histories of breast cancer, it is important to note that these results do not rule out the possibility that some specific aspects of emotion-focused coping may be adaptive for these women. For example, we have recently reported that higher levels of emotional expressivity are associated with reduced distress among women with family histories of breast cancer (45). Studies of breast cancer

patients have found that coping approaches such as emotional expression or active emotional processing are adaptive (e.g., 46). The coping measure used in the present study, the Ways of Coping Questionnaire, may not be optimal for assessing these aspects of emotion-focused coping, as it includes only a small number of items that tap these constructs (46). Future studies should confirm and extend the findings in the present study by including coping measures that assess the broad range of emotion-focused coping strategies.

Despite these limitations, to our knowledge, the present study provided the first demonstration in the literature that emotion-focused coping may have negative consequences for women with family histories of breast cancer. The present findings also provide support for the importance of problem-focused coping in determining levels of positive affect among women confronting daily life stressors. These initial results suggest the importance of additional research to better understand the impact of coping strategies on day-to-day affect, as well as distress specifically associated with a history of cancer in close relatives.

The present results also have implications for the development and targeting of interventions for healthy women who have experienced breast cancer in their families. It is tempting to speculate that these women may benefit from individualized coping training programs designed to minimize negative aspects of emotion-focused coping strategies (e.g., suppressing or denial) to reduce cancer-specific distress. Based on the present results, interventions to enhance problem-focused coping strategies (e.g., 47-49) might be explored for their general beneficial impact on positive affect.

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Table 1. Coping Strategies and Psychological Outcomes by Family History Group

	FH+	FH-	F
<u>Coping Strategies</u>			
Emotion-focused	1.14 ( 0.51)	1.41 ( 0.50)	6.48*
Problem-focused	1.59 ( 0.54)	1.81 ( 0.48)	4.94*
<u>Psychological Outcomes</u>			
IES	13.40 (13.50)	9.85 (11.72)	1.56
Negative Affect	2.27 ( 2.89)	3.79 ( 5.19)	2.35
Positive Affect	17.76 ( 4.06)	17.02 ( 4.23)	.88

\*  $p < .05$

Note. Mean (SD);

FH+ = women with family history of breast cancer;

FH- = women without family history of breast cancer;

IES = total composite score of Impact of Event Scale

Table 2. Hierarchical Regression on Breast Cancer-specific Distress (IES), Negative Affect, and Positive Affect

	IES		Negative Affect		Positive Affect	
	R <sup>2</sup>	$\beta$	R <sup>2</sup>	$\beta$	R <sup>2</sup>	$\beta$
<u>Step 1: Covariates</u>						
Income	.11	-.21*	.32	-.33***	.08	-.07
Perceived Risk		.29**		.08		.06
<u>Step 2: Main Effects</u>						
Family History (FH)	.21	.20*	.49	-.06	.29	.15
Emotion-focused coping (E)		.29**		.38***		.01
Problem-focused coping (P)		.06		-.04		.26**
<u>Step 3: Interaction Effects</u>						
FH x E	.25	1.45*	.51	-.72	.33	.63
FH x P		.55		-.22		.81
E x P		.56		-.41		.85
FH x E x P		-1.17		.29		-.53

\*  $p < .05$     \*\*  $p < .01$

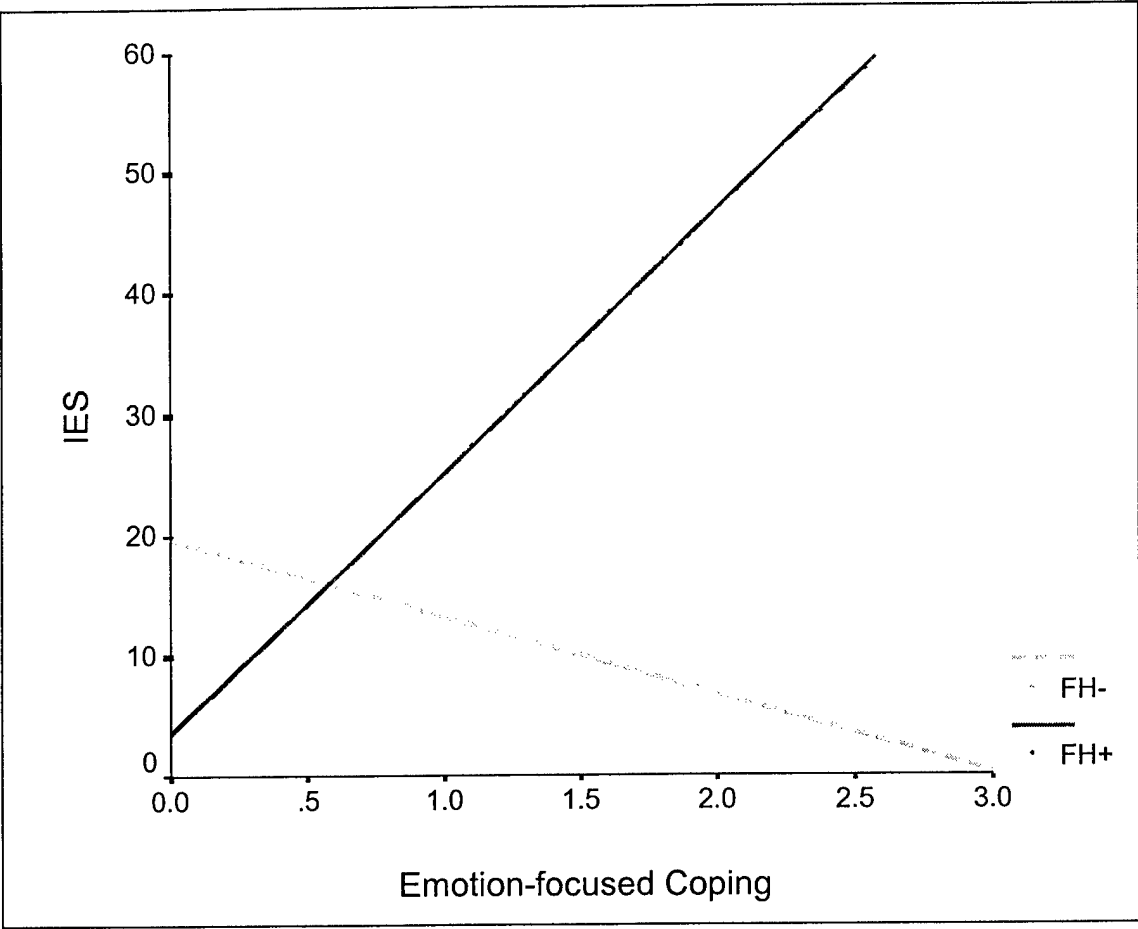
Note: Income: 0 for  $\leq 20K$ , 1 for  $> 20K$ ;  
Family History (FH), 0 for women without family histories of breast cancer,  
1 for women with family histories of breast cancer



Figure Labels

Figure 1. Interaction effect of FH and emotion-focused coping on IES

Figure 1.



Note: FH- : Women without family histories of breast cancer;  
FH+ : Women with family histories of breast cancer

Family Histories of Breast Cancer, Health Locus of Control, and Coping

Youngmee Kim, Heiddis B. Valdimarsdottir, and Dana H. Bovbjerg  
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Having first-degree relatives with breast cancer as a major life event can influence how women in the family cope in general. First, it was examined if these women (FH+) utilize emotion-focused or problem-focused coping strategies in differing degrees from women without such family history (FH-). Second, beliefs in health locus of control as potential mediators in the relation between family histories of breast cancer (FHBC) and coping strategies were tested. One hundred sixteen healthy women (47 FH+ and 69 FH-) participated in the study. They completed the Ways of Coping Questionnaire (measuring emotion-focused and problem-focused coping strategies) and the Multidimensional Health Locus of Control Scale (MHLOC: measuring internal, external, and impersonal health locus of control). Results showed group differences in utilizing coping strategies: FH+ women utilized both emotion-focused ( $\beta = -.27, p = .004$ ) and problem-focused coping strategies ( $\beta = -.20, p = .035$ ) less frequently than FH- women. Associations between FHBC and MHLOC dimensions were also found (for each MHLOC dimension,  $\beta$ s =  $-.27, -.18, -.20, p$ s =  $.027, .079, .045$ , respectively), but only external LOC was significantly associated with emotion-focused coping. When both FHBC and external LOC were included in the analysis, the relation between FHBC and emotion-focused coping became weaker ( $\beta = -.22, p = .024$ ), indicating partial mediating effect of external LOC. The MHLOC measures were not significantly associated with problem-focused coping. The results suggest that the FH+ women believe less that others (e.g., health professionals) can control their own health, which in turn is associated with lower degree of utilization of emotion-focused coping strategies.

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Word count: 307 (max 300)

THE EFFECT OF CHANGES IN FAMILY CONFLICT ON CHANGES IN POST-TREATMENT NAUSEA: AGE DIFFERENCES

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The family systems theory (Steinglass, 1987) encompasses the dynamics between a family's growth tendency to become structurally more complex and its regulatory tendency to remain stable and orderly. Cancer of a family member is a major destabilizer in the family system, and thus may alter familial relationships and change the family system. The impact of changes in a family's influences on the development of side effects from receiving chemotherapy has been understudied. This study is aimed at examining the potential role of changes in family conflict, along with the patient's age. Three hundred and twenty eight cancer patients (164 males, 164 females), diagnosed with hematologic neoplasms (62%), lung cancer (21%), or alimentary tract cancer (17%), from Community Clinical Oncology Program sites, were studied. Mean age of the patients was 56.9 (ranged 18 to 89). The patients completed the Family Environment Scale and the Morrow Assessment of Nausea and Emesis (MANE) at the second and fifth infusions. Hierarchical regression analysis showed that the relations between changes in family conflict and the development of patient's post-treatment nausea depended on the patient's age. Specifically, for younger patients, an increase in family conflict was associated with increased severity (slope = .21) and duration (slope = 5.60) of post-treatment nausea, while this pattern was not significant for older patients ( $ps < .05$ ). The findings of the present study suggest that the family influences a patient's adjustment to a medical situation and younger patients will benefit from intervention programs designed to help them avoid conflict among family members.

Character Count (including space) 1804 (max 2236).

Familial Risk of Cancer and Distress: Role of Neuroticism and Extraversion

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Distress levels in individuals confronting life stresses are known to be impacted by personality variables, particularly neuroticism and extraversion. Although familial risk (FR) of cancer is clearly a life stress, the moderating effects of these personality variables have not been examined. In the present study, 75 healthy women with one or more first degree relatives with breast cancer (FR+) and 140 without such histories (FR-) completed validated measures of neuroticism and extraversion (NEO-FFI), cancer-specific distress (Impact of Event Scale – IES), and general distress (Profile of Mood States - POMS). There were no significant differences in these personality traits by familial risk group. Hierarchical regression analyses revealed that three main effects: the FR+ women, and women high in neuroticism or low in extraversion were more likely to report a higher level of cancer-specific distress ( $p$ s < .001). In addition, a positive association between neuroticism and IES was more prominent for the FR+ women than the FR- women ( $p$  = .001). The interaction between extraversion and FR group on IES was not significant. In contrast, the personality factors (neuroticism and extraversion) were significantly associated with general distress ( $p$ s < .001), but there were no main effects of familial risk group or interaction effects on general distress. The findings imply that breast cancer-specific distress is a function of an individual's personality and status of familial risk of breast cancer, while general distress is affected by personality, but not by familial risk.

Character count (including space): 1738 (max 2236)

Coping Strategies as Moderators of Cancer-specific Distress  
Among Healthy Women with Family Histories of Breast Cancer

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Healthy women with family histories of breast cancer (FH+) have been reported to have higher levels of cancer-specific distress, which is driven in part by higher levels of perceived cancer risk. Individual differences in coping strategies have yet to be explored as possible moderators that could account for variability in these women's distress levels across and within studies. To address this possibility, we recruited an urban community sample (77% African American, mean age = 43) of healthy women with and without first degree relatives with breast cancer (47 FH+, 69 FH-). Participants completed questionnaires assessing perceived risk of breast cancer (0-100%), cancer specific distress (Impact of Event Scale, IES), and coping (Ways of Coping Questionnaire, WCQ). Two higher order coping strategies, "emotion-focused" and "problem-focused" were revealed by factor analysis. The hypothesized interactions between FH group and the two coping strategies in predicting IES scores were examined with hierarchical regression analysis with perceived risk as a covariate. Consistent with the literature, we found a significant relation between perceived risk and cancer-specific distress. Analyses also revealed for the first time, a significant interaction between FH group and emotion-focused coping ( $p < .05$ ), such that emotion-focused coping was associated with a higher level of cancer-specific distress only in the FH+ group ( $\beta = .83, p < .05$ ). Supporting the distinction between these coping strategies, use of problem-focused coping was not found to be associated with cancer-specific distress. These results suggest that emotion-focused coping strategies (e.g., denial, emotional suppression) are particularly maladaptive for women confronted with the stress of having a family history of breast cancer. Psychological interventions targeted on emotion-focused coping may be most effective for these women. (Supported by NCI grant CA72457, Bovbjerg).

Character count (including space): 2220 (max 2236)

## Depression in Spouses of People with Lung Cancer: Personality, Social Support, and Caregiving Burden

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Personality traits predict the onset, recurrence, and exacerbation of depression in community dwellers, but little is known about personality and depression in other contexts. We used structural equation modeling to address this issue in a study of 117 spouses of lung cancer patients. We examined (a) the direct relation between personality and depression (measured by the CES-D) and (b) the indirect relation through the hypothesized mediators of social support (Duke Index) and caregiver burden (Zarit Scale). A latent variable, derived from the NEO-FFI Neuroticism scale, the LOT-R (Optimism) and Rodin Self-Efficacy scale was created to measure high-risk traits that increase risk of depression. Results showed that the direct path from high-risk traits to depression was significant when the hypothesized mediators were excluded from the model,  $\chi^2(4) = 4.42$ , GFI = .99, and RMSEA = .03. The overall model remained significant when the mediators were included,  $\chi^2(29) = 51.86$ , GFI = .93, and RMSEA = .08. The link between high-risk traits and depression was mediated by caregiver burden, not by social support. High-risk traits were marginally associated with caregiver burden ( $\beta = .19$ ,  $p < .08$ ), which, in turn, increased depression ( $\beta = .46$ ,  $p < .001$ ). The relation between social support and depression was mediated by caregiver burden. Higher levels of social support were associated with decreased burden ( $\beta = -.46$ ,  $p < .001$ ), which, in turn, reduced depression ( $\beta = -.46$ ,  $p < .001$ ). These findings are generally consistent with the literature on depression in community samples and suggest that spousal caregivers at risk for depression may benefit from programs that can help allay the strains associated with the caregiving role.

INHIBITING DEVELOPMENT OF ANTICIPATORY NAUSEA:  
THE EFFECTS OF FAMILY SUPPORT, PATIENT'S ANXIETY, AND POST-TREATMENT  
NAUSEA

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The degree of support in the family has been suggested as a psychological predictor of chemotherapy-related nausea, however, how it predicts remains unclear. This study examined the potential role of family support in the development of anticipatory nausea, directly or indirectly through reducing either a patient's anxiety or development of post-treatment nausea. Nine hundred sixty four cancer patients from 21 Community Clinical Oncology Program sites were studied. The patients completed the Family Environment Scale, anxiety measures (e.g., STAI and POMS), and the Morrow Assessment of Nausea and Emesis (MANE), before their second chemotherapy treatment. A questionnaire packet, including the anxiety measures and the MANE, was then given to the patient to complete after each chemotherapy treatment up to and including the fifth treatment. The full model, including direct and indirect paths, was examined at each infusion from the second through the fifth. The fits of the specified model were satisfactory. Results from structural equation modeling suggest that family support plays an important role in reducing a patient's anxiety, which, in turn, inhibits subsequent development of chemotherapy-related anticipatory nausea. Specifically, the paths from family support to anxiety (-), from anxiety at N - 1 to post-treatment nausea at N - 1 (+), from anxiety at N - 1 to anticipatory nausea at N (+), and from post-treatment nausea at N - 1 to anticipatory nausea at N (+) were significant across infusions. The findings support the general proposition from the family systems theory and provide empirical evidence that the family influences a patient's adjustment to medical situations, specifically, nausea related to chemotherapy. The findings also suggest that patients and families will benefit from intervention programs which help them express feelings openly while avoiding conflict and criticism, and maintaining a balanced family structure.



# Specialized and Fragmented Cognitive Concepts on the Self and Romantic Relationships

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Running Head: Self and Relationship Complexities

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### Abstract

Self-complexity models were applied to the area of romantic relationship-complexity. The extent to which the prior contradictory findings on the degree of cognitive complexity and affect reactivity, defined in its specialized vs. fragmented aspects, was also tested. Results revealed that relationship complexity measures were related to, but not identical with self complexity measures. Affect reactivity in the romantic relationships domain was not predicted by cognitive complexity measures alone but by the induced mood condition or the status of romantic relationship involvement. The buffering or enhancing effect of the specialized relationship concept on affect reactivity depended on the length of the relationship or the status of relationship involvement. The validity of relationship complexity measures in the domain of close relationships was discussed.

Cognitive concepts on the self have been studied from various perspectives such as the self-complexity (Linville, 1985) and self-concept differentiation approaches (Donahue, Robins, Roberts, & John, 1993). Cognitive concepts on the romantic relationships, however, have been understudied and the relation with cognitive concepts on the self has not been clear. In the present study, two approaches were applied to the romantic relationship domain to develop two measures of romantic relationship concepts. The effects of the developed measures on affect reactivity were also examined.

Linville's (1985) self-complexity model is based on an assumption that the self-concept is a complex structure that helps to organize and process vast amounts of self-relevant knowledge. Based on this assumption, Linville (1985) defined self-complexity in terms of the "number of aspects of self that are relatively independent" (p. 95). Self-complexity has two components: (a) the number of attributes used to organize knowledge about the self cognitively; and (b) the degree of relatedness among these attributes. Maximal complexity occurs when many differentiated elements are independent, while simplicity occurs with few components or high interdependence among components (Linville, 1985). The impact of an experience with respect to one attribute spreads to other attributes according to the strength of their relatedness (Andersen & Cole, 1990). To be complex is to have a low degree of relatedness among self attributes and therefore to experience less spill-over. Several studies (Linville, 1985, 1987; Margolin & Niedenthal, 2000; Niedenthal, Setterlund, & Wherry, 1992; Smith & Cohen, 1993) have shown that individuals with high self-complexity have less variable emotions than those with low self-complexity. In Linville's model, high self-complexity can be seen as having "specialized"

concepts that enable them to respond flexibly and adaptively to different roles, and to improve functioning within roles (Gergen, 1971).

Donahue, Robins, Roberts, and John (1993) present an alternative to the specialization view of the differentiated self, suggesting that such differentiation reflects a fragmentation or lack of an integrated core self. This "fragmented" self-concept is seen as rigid and inflexible, constraining the individual from reacting multiple role requirements effectively (Gergen, 1971). Donahue and colleagues (1993) found that individuals with high levels of self-concept differentiation (SCD) showed poor emotional adjustment (e.g., depression, emotional distress), supporting the fragmented rather than the specialized view of the self (Donahue et al., 1993). The fragmented self-concept model (Donahue et al., 1993), in contrast with the specialized self-concept model (Linville, 1985), implies that more cognitively complex individuals experience more extreme emotional reactions resulting from the generation of a greater emotional arousal across cognitive domains. On the other hand, individuals, who need moderate and stable emotions, structure their social activities and networks in less differentiated ways (Emmons & King, 1989). Several studies have supported this model (Donahue et al., 1993; Larsen & Diener, 1987; Reifman & Crohan, 1993).

Some speculation is plausible for the present conflicting findings between the specialized and fragmented models. Theoretically, cognitive complexity has two components: (a) differentiation (i.e., the number of different elements) and (b) integration (i.e., the hierarchical synthesis of the different elements) (Crockett, 1965). Methodologically, the two models may measure different degrees of these components in cognitive complexity. In Linville's self-complexity approach, participants are asked to

complete a trait-sorting task, which requires creating a sophisticated, open-ended self-portrait. In creating piles of trait cards reflecting different self-attributes, participants may ponder themselves into differentiated selves keeping a "self in general." Thus, in Linville's method, "differentiating" one's self-attribute does not seem totally independent of integrating those self-attributes within the self. That is, the cognitive concepts measured by Linville's method may include both components of cognitive complexity (i.e., integration and differentiation), supporting the specialized cognitive concept view.

In Donahue's self-concept differentiation approach, however, participants are asked to rate themselves on each self-trait under a given role dimension. Specifically, they evaluate themselves repeatedly on the same traits but for different role dimensions, and for any new rating in a role they cannot refer back to ratings on prior roles. Thus, in Donahue's method, differentiating one's self-attribute across different roles appears to be attainable, independent of the integrating facet. That is, the cognitive concepts measured by Donahue's method may include differentiation only, resulting in reflecting fragmented cognitive concepts. This procedure may prevent subjects from integrating self descriptions across different role dimensions. Differentiation may be triggered by the "buffering mechanism" only when integration also exists (Sheldon & Emmons, 1993). Without a coexisting integration process, differentiation itself may be regarded as unresolved intrapsychic fragmentation. For example, the self-concept differentiation (SCD), including only the differentiation element of cognitive complexity (Crockett, 1965), has been associated with individuals' ill-beings (e.g., Donahue et al., 1993). Thus, the method that measures the differentiation aspect of cognitive complexity may result in more directly

positive correlations between cognitive complexity and emotional reactivity, because it implies a fragmented, less well-adjusted model of the self.

Although most prior research on cognitive complexity has examined the impact of self-complexity on success and failure in achievement-oriented tasks (Dixon & Baumeister, 1991; Linville, 1985; Niedenthal et al., 1992), recent studies have applied the self-complexity model to relationships or marriage. For example, based on the feedback of success or failure that they gave subjects about their ability to have high quality dating relationships or future marriages, Niedenthal and colleagues (1992) found that self-complexity correlated negatively with affective reactivity, supporting Linville's specialized self-concept model. On the contrary, Reifman and Crohan (1993) applying the self-complexity model to interpersonal relationships obtained contrary findings. That is, a greater redundancy in a perceiver's cognitive representation of the partner was associated with more positive and less negative affect felt toward the partner.

Relationship schemas (Baldwin, 1992), which refer to cognitive structures about self, other, and interpersonal relationships, reflects and guides patterns of interpersonal relatedness (Andersen & Cole, 1990; Horowitz, 1989). This definition implies that relationship schema may share elements with self schema, but are neither identical with, nor a subset of self schema. Thus, measuring relationship cognitive concepts corresponding to the cognitive self-concepts (e.g., self-complexity, self-concept differentiation) is required to clarify the overlap between the self- and relationship-cognitive concepts, and further to clarify the inconsistent findings when cognitive self-concepts are applied to relationship domain.

Based on similarity with the self, relationships may be represented with more or less cognitive complexity. In other words, people may differ in the degree of complexity of their relationship representation. Here, the term *specialized relationship-concept* is defined as a cognitively differentiated concept about a romantic relationship that responses adaptively to different role requirements within romantic relationship roles. The specialized relationship-concept is assumed to have many different relationship attributes relatively independent of different roles as a romantic partner. The term *fragmented relationship-concept* is defined as a cognitive organization in which different attributes of a relationship are rated in distinctive ways across romantic relationship roles.

Just as specialized self-schemas, following Linville's logic, buffer people against affect reactivity within a single domain, so should specialized relationship schemata buffer a person from affect reactivity within the domain of close relationships. That is, the cognitive complexity of individuals' relationship attributes may negatively relate to the extremity of their reaction to emotional events within the relationship. On the other hand, just as fragmented self-schemas, according to Donahue's logic, enhance the individuals' affect reactivity, so should fragmented relationship schemata enhance a person's affect reactivity within the domain of close relationships<sup>1</sup>.

The present study seeks to apply self-complexity research to the area of romantic relationship-complexity, and to clarify prior contradictory findings about the relation between degree of cognitive complexity and affect reactivity by comparing cognitive complexities defined in its integrative vs. differentiated aspects.

## Method

### Preliminary Study

### Participants and Procedure

Fifty University of Rochester undergraduates participated in a pretest session to generate a list of attributes and roles that people would use to describe romantic relationships. In an open-ended task, similar to that used by Linville (1985), they were asked to: (a) list adjectives both positive (e.g., "fun") and negative (e.g., "jealous"), and nouns relevant to the description of romantic relationships, and (b) identify roles participants take in romantic relationships (e.g., "friend", "sexual partner").

### Results

Based on frequencies of attributes and roles nominated, 32 romantic relationship-attributes (21 positive adjectives; 11 negative adjectives), and 4 romantic relationship roles were selected for use within the primary research (see Table 1).

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 Insert Table 1 about here  
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### Main Study

#### Participants

One hundred sixty two undergraduate students (66 men and 96 women), who were currently involved in a romantic relationship or had been involved in a romantic relationship in the past, participated in a two-session study as part of their introductory psychology research requirement. Among the participants, 54.9% were currently involved in a romantic relationship, 44.4% were not currently involved in a romantic relationship, and one participant did not indicate their current relationship status. The mean relationship length was 16.94 month (SD = 14.05), and ranged from 1 to 96 months with a median of



12 months. The status of current relationship involvement and the length of a relationship were included in the subsequent analyses.

### Procedure and Design

Session A: Participants in a group of one to four were seated at individual booths separated by room dividers and completed a mood checklist, followed by trait-sorting tasks for the romantic relationship and the self (Linville, 1987). Task order was counterbalanced. Specialized self-complexity (SSC) and specialized relationship-complexity (SRC) scores were derived from responses on these tasks (Linville, 1987). Participants were then asked to describe relationship events with their current or past romantic partners that were positive or negative, depending on their recall condition. After writing one or two paragraphs, subjects were again asked how they felt using the mood checklist.

Session B: Session B took place at least two weeks after session A, again with one to four subjects at a time. Participants completed the mood checklist, then did self-ratings for their romantic relationship on 33 self-traits for five self roles (Table 2) and 32 relationship-attributes for four romantic relationship roles. Fragmented self-concept (FSC) and fragmented relationship-concept (FRC) scores were derived from responses on these tasks (Donahue et al., 1993). Task order was again counterbalanced. Then, participants completed a positive or negative recall task, depending on their recall condition, followed by the mood checklist measure. At the end of the second session, participants were fully debriefed.

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Insert Table 2 about here

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The order of the two sessions was counterbalanced. The study was a mixed design with two within-subject factors (self vs. relationship concepts; specialized vs. fragmented concepts) and one between-subject factor (positive vs. negative recall condition).

### Measures

Specialized Self-Complexity (SSC). Linville (1987) devised standard procedures for the card-sorting task which was used to measure self-complexity. Subjects were given a packet of 33 (Linville, 1987) randomly ordered index cards, 20 blank cards, and a legal sized sheet with 15 columns. Each of the 33 index cards listed one characteristic and a number in the corner. Subjects were asked to sort self-descriptive traits into groups that would represent different self-aspects. Any given trait could be assigned to more than one group, using blank cards. Subjects were told that they had 20 minutes for this task, but that they could stop whenever they had created all groupings that were meaningful to them. Subjects who could not finish in 20 minutes were given five more minutes. After completing the sorting task, subjects were asked to transcribe the numbers corresponding to each sorted card and label each group of traits onto the blank coding sheet.

The resulting sort was used to calculate Scott's  $H^2$  measure of differentiation among attributes or "dimensionality."  $H$  reflects both the number of groups in a sort and the extent to which groups do not share common traits (Scott, Osgood, & Peterson, 1979).

Specialized Relationship-Complexity (SRC). The same card-sorting task was used to measure relationship-complexity by having subjects sort 32 randomly ordered index cards listing attributes of romantic relationships. Individuals who were currently involved in a romantic relationship, were asked to think about the current romantic relationship

when engaging in the task. For individuals who were not currently involved in a romantic relationship, they were asked to think about one of their past romantic relationship.

Fragmented Self-Concept (FSC). Subjects rated themselves on 33 self traits (Linville, 1985), five times for each of five social roles: student, friend, romantic partner, son or daughter, and worker (Donahue et al., 1993), using an 8-point Likert scale (1 = "little like me", 8 = "extremely like me"). Each role was presented on a separate page, and subjects were not permitted to refer back to prior ratings. The 33 attributes were presented in a different order for each role.

To compute FSC, factor analysis was used to assess the proportion of variance in the role-identity ratings not shared across roles, following procedures developed by Block (1961). For each subject, a factor analysis was conducted on the 5 X 5 matrix of the five role identities across the 33 attributes. Because the FSC index is derived from correlations among role identities, it indicates the extent to which an individual's ordering of the attributes, from most to least descriptive, varies from role to role. The FSC index can also be expressed as the mean intercorrelation among the five role identities (Donahue et al., 1993).

Fragmented Relationship-Concept (FRC). The same procedure was followed to rate roles and attributes of romantic relationships, based on 4 romantic partner roles and 32 attributes of romantic relationships, identified from pretest data. The same instructions were given regarding the current involvement of romantic relationship when participants rated the attributes.

Mood Induction: Autobiographical Recall of Romantic Relationships: Participants were asked to make themselves comfortable and focus on the written instructions. They

were asked to think about a romantic relationship, present or past, whether or not they were currently involved, and to picture events with that partner as vividly as they could. They were then asked to recall 2 positive or negative incidents within the relationship, depending on recall condition. The brief instructions for positive incidents were "Think about a time when you felt very in love with her/him," and "Think about a time when s/he did something which really made you feel special." The instructions for negative incidents were "Think about a time when you were talking about breaking up," and "Think about a time when s/he made you really mad." Subjects were asked to write one or two paragraphs about the two positive or negative incidents. At each session, different recall scenarios were used. Then, mood was measured again with the same mood checklist, with a new randomized order of adjectives.

Affect Reactivity: The self-report mood measure consisted of three or four adjectives from each of four subscales of the Nowlis (1965) Mood Adjective Checklist (MACL): Activity, Anxiety, Happiness, and Sadness. A depression item was also included. Subjects indicated how much they felt each of the 14 adjectives at the time using the following response format: definitely do not feel \_\_\_\_\_ definitely do feel. These responses were later assigned 1-7 values, respectively, for scoring. This was done both for average pretest and posttest mood scores (MACL<sub>1</sub> and MACL<sub>2</sub>). Responses to positive and negative mood items were summed, the latter was subtracted from the former to produce a single score (MACL). Responses were keyed so high MACL scores, namely affect reactivity, reflected more positive moods, followed Linville (1987).

## Results and Discussion

### Descriptives

Specialized self- and relationship-concept scores range between 1 and  $\log_2 n$  ( $n$  = number of traits;  $n = 33$  for specialized self-concept and  $n = 32$  for specialized relationship-concept). Higher scores indicate greater specialized self or relationship complexity. Thus, the specialized self-concept (SSC) could range between 1 and  $\log_2 33 = 5.04$ . The actual range of scores was between 1.15 and 4.78 ( $M = 3.33$ ,  $SD = .66$ ). The number of actual groups created ranged from 2 to 15 ( $M = 6.72$ ,  $SD = 2.40$ ). These results are comparable to those reported by Linville (1985, 1987). The specialized relationship-complexity (SRC) could range between 1 and  $\log_2 32 = 5.00$ . The actual range of scores varied between 1.26 and 4.52 ( $M = 2.89$ ,  $SD = .67$ ), and number of groups created again ranged between 2 and 15 ( $M = 4.89$ ,  $SD = 2.10$ ).

On the other hand, the fragmented self-concept (FSC) and fragmented relationship-concept (FRC) could range from 0% to 100% (higher percentages indicate more fragmented self/relationship concepts). FSC ranged between 42.7% and 74.4% ( $M = 60.78\%$ ,  $SD = 6.14$ ), whereas FRC fell between 41.7% and 71.2% ( $M = 57.16\%$ ,  $SD = 5.00$ ). With 60 traits and 5 roles, Donahue and colleagues (1993) reported means of 24.6% ( $SD = 12.4$ ) or 24.2% ( $SD = 16.3$ ), suggesting that the present study means were somewhat more differentiated, but relatively less variable.

#### Self versus Relationship Concepts

Because relationship-concepts (SRC or FRC) may have many of the same cognitive and motivational properties as self-concepts (SSC or FSC), the degree to which self and relationship concepts covaried along with other study variables was examined (Table 3). As shown in Table 3, gender was not correlated with any study variables, except the marginally positive correlation with the specialized self-concept. The specialized self-

concept (SSC) correlated significantly and positively with the specialized relationship-concept (SRC) and fragmented relationship-concept (FRC), and marginally positively with the fragmented self-concept (FSC); the SRC was significantly and positively correlated with FRC, marginally positively with both FSC and affect reactivity at the pre-recall test, and marginally negatively correlated with the length of the relationship. The FSC was significantly and negatively related to affect reactivity at both pre- and post-recall tasks, and marginally positively related to FRC. The FRC was not significantly related to any study variables.

The results in the present study showed that both relationship-concepts were positively associated with self-concepts and the magnitude of association was stronger between specialized concepts than between fragmented concepts. Relationship complexity measures were related to, but not identical with self complexity measures, suggesting some independence for the former concept. The fact that relationship concepts had an average of 5 actual roles in a romantic relationship created, whereas there were 7 for self roles also suggests that relationship concepts are somewhat less differentiated than the self concepts. In addition, the correlations between the different models of the self or relationships were either marginal or significant, but the magnitude of the correlations was small, validating the expected theoretical and methodological differences in specialized versus fragmented cognitive concept models.

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 Insert Table 3 about here  
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#### Cognitive Concepts and Affect Reactivity

To examine the effects of relationship complexities (specialized vs. fragmented), mood manipulation (positive vs. negative relationship event recall), the length of the relationship, and status of romantic relationship involvement, on changes in affect reactivity, a hierarchical regression analysis was used. The criterion variable was affect reactivity at the post-recall task. The degree of affect reactivity at the pre-recall task and a contrast code for gender were entered in the first step, followed by the two self complexity measures (i.e., SSC and FSC) in the second step. The main study variables, two relationship complexity measures (i.e., SRC and FRC), a contrast code for induced mood condition, the length of the relationship, and the status of relationship involvement, were entered in the third step, followed by two-way interactions among these variables in the fourth step (Table 4).

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 Insert Table 4 about here  
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As shown in Table 4, both the self complexity and relationship complexity measures individually did not significantly account for the variance in changes in affect reactivity. The changes in affect reactivity were greater in the positive recall condition than in the negative recall condition, indicating the manipulation was successful. In addition, the changes in affect reactivity were greater for individuals who were involved in a romantic relationship than those who were not.

Three two-way interactions were significant. The significant interaction between the specialized relationship concept (SRC) and the length of the relationship indicates that

individuals who had a longer relationship showed less affect reactivity, which is more prominent among individuals high in SRC than individuals low in SRC. On the other hand, the significant interaction between specialized relationship concept (SRC) and involvement in a romantic relationship indicates that individuals low in SRC who were involved in a romantic relationship showed less affect reactivity than those who were not involved, while individuals high in SRC who were involved in a romantic relationship showed greater affect reactivity than those who were not involved. It appears that SRC's buffering or enhancing effect on affect reactivity depends on either the length of the relationship (i.e., buffering effect of relationship length) or the status of involvement in a romantic relationship (i.e., enhancing effect of involvement). Finally, the significant interaction between the condition of mood induction and the length of the relationship indicates that as individuals had longer relationships, they showed less affect reactivity in a positive recall condition than in a negative recall condition, demonstrating again the buffering effect of relationship length.

According to the specialized cognitive concept model (Linville, 1985, 1987), highly differentiated relationship concepts should help individuals to be adaptive to different role requirements in a romantic relationship. The results of the present study partially support this model and also underscore the importance of other relationship factors such as the status of involvement or the length of the relationship. It appears that a longer relationship plays as an integrator of differentiated cognitive concepts across roles in a romantic relationship and creates harmony between cognitive concepts and affect reactivity. The status of involvement in a romantic relationship may be a relatively unstable factor for the college students in the present study which is associated with a greater degree of spill-over



effect. On the other hand, the length of a romantic relationship may be an indicator of a relatively secure relationship which is associated with lesser degree of spill-over effect. This finding should be replicated with other populations such as older or married couples.

The cognitive concept, either specialized or fragmented, alone did not show that the hypothesized association with affect reactivity and the fragmented relationship concept was not associated with affect reactivity along with other relationship factors. However, the findings in the present study imply that the relationship concepts significantly contribute to the understanding of affect reactivity in romantic relationships above and beyond the roles of self concepts. In addition, the findings imply that the length of a relationship is important for deciphering the association between relationship concepts and affect reactivity.

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## Footnote

1. Suppose, for example, that romantic partners agree to go to a movie one night, and partner "A," without notice, fails to show up. Suppose also that partner "B" has a relatively simple relationship representation in which companionship attributes are closely linked to friendship and sexual partnership (i.e., low relationship complexity). Presumably, the negative affect associated with mistrust in companionship will be widespread, resulting in negative feelings about other areas of the close relationship such as friendship and sexuality. According to Linville's model, individuals with highly differentiated self/relationship-concepts can have specialized identities that enable them to respond flexibly and adaptively to different role requirements, via the "buffering mechanism of complexity." Thus presumably, in this example case, the person's negative affect associated with mistrust in companionship will not be widespread, resulting in intact other areas of the close relationship such as friendship and sexuality. According to Donahue's model, however, individuals with highly fragmented self/relationship-concepts may not be able to respond flexibly and adaptively to different role requirements. Thus presumably, the negative affect associated with mistrust in companionship will be widespread, resulting in negative affects in other areas of close relationship such as friendship and sexuality.
2. Scott's H is derived from the following formula:  $H = \log_2 N - (\sum n_i \log_2 n_i) / N$ , where N is the total number of traits in the card deck and  $n_i$  is the number of traits that appear in a given combination of piles constructed by the subjects,  $N = \sum n_i$

Table 1. List of romantic relationship attributes and roles

Romantic Relationship Attributes


---

dependent	open-minded	worried
warm	uncertain	mean
time-consuming	trustworthy	attentive
exciting	loving	jealous
fun	ambivalent	caring
boring	argumentative	honest
angry	secure	energetic
understanding	intimate	possessive
sexy	comfortable	close
supportive	attractive	selfish
sharing intellectual ideas		happy

Romantic Relationship Roles


---

friend	confidant / supporter
sexual partner	companion / playmate

Table 2. Lists of self-traits and social roles

Self Traits


---

competitive	quiet	relaxed
rude	organized	unfriendly
affectionate	studious	reflective
soft-hearted	not studious	unconventional
impulsive	shallow	reserved
unorganized	conformist	irresponsible
humorous	reckless	anxious
individualistic	insecure	mature
imaginative	lazy	industrious
outgoing	assertive	playful
sophisticated	rebellious	emotional

Social Roles


---

student	friend	romantic partner
son or daughter	worker	

Table 3. Correlations among study variables

	2	3	4	5	6	7	8	9
1. Gender	.15+	.09	-.04	-.03	.08	.05	.06	-.03
2. SSC	-	.45***	.15+	.17*	-.06	.05	.06	-.04
3. SRC		-	.14+	.20**	-.17+	.06	.15+	.03
4. FSC			-	.14+	.00	.07	-.18*	-.16*
5. FRC				-	-.08	.07	-.02	-.05
6. Length					-	-.02	-.04	-.09
7. Involvement						-	.13	.28***
8. Affect Reactivity-pre							-	.55***
9. Affect Reactivity-post								-

+  $p < .10$ \*  $p < .05$ \*\*  $p < .01$ \*\*\*  $p < .001$ 

Note: Gender = 1 for women, -1 for men;

SSC = Specialized Self-Concept; SRC = Specialized Relationship-Concept;

FSC = Fragmented Self-Concept; FRC = Fragmented Relationship-Concept;

Length = romantic relationship length;

Involvement = 1 for Current involvement, 0 for non-current involvement;

Affect Reactivity-pre = Positive relative to negative mood at the pre-recall test;

Affect Reactivity -post = Positive relative to negative mood at the post-recall test

Table 4. Hierarchical Regression Analysis on Affect Reactivity at the Post-recall Task

	R <sup>2</sup>	$\beta$	t
<u>Step 1</u>	.31		
Affect reactivity-pre		.56	8.26***
Gender		-.06	-.95
<u>Step 2</u>	.32		
SSC		-.06	-.87
FSC		-.04	-.64
<u>Step 3</u>	.40		
SRC		-.03	-.34
FRC		-.02	-.29
Mood Induction (M)		.16	2.40*
Length (L)		-.08	-1.22
Involvement (I)		.22	3.33**
<u>Step 4</u>	.47		
SRC x FRC		-1.24	-1.33
SRC x M		-.38	-1.31
SRC x L		-.52	-2.13*
SRC x I		.91	2.88**
FRC x M		1.22	1.63
FRC x L		.17	.19
FRC x I		.08	.11
M x L		.28	2.23*
M x I		-.02	-.16
L x I		-.05	-.37

\*  $p < .05$       \*\*  $p < .01$       \*\*\*  $p < .001$

Note: Affect reactivity-pre = Positive relative to negative mood at the pre-recall task;  
 Gender = 1 for women, -1 for men;  
 SSC = Specialized Self-Concept; FSC = Fragmented Self-Concept;  
 SRC = Specialized Relationship-Concept;  
 FRC = Fragmented Relationship-Concept;  
 Mood Induction = 1 for positive recall condition, -1 for negative recall condition;  
 Length = romantic relationship length;  
 Involvement = 1 for Current involvement, 0 for non-current involvement



Parental Adjustment in Childhood Cancer: Marital and Occupational Issues

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Running head: parental marital and occupational adjustment

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### Abstract

This survey study explores marital and occupational adjustment among parents of children with cancer and compares the experiences of parents of living children and bereaved parents. Fifty parents of living children with 22 bereaved parents participated. Results revealed that the child's diagnosis or death per se did not affect marital adjustment. However, level of perceived stress in each partner did impact marital adjustment. Changes in job status attributed to the child's diagnosis or death are common, but use of the Family Leave Act or Employee Assistance Program was rare. Participants suggested interventions to improve parents' marital and occupational satisfaction while coping with their child's illness.

Key Words: childhood cancer; marital adjustment; occupational adjustment

Although intensive, aggressive therapy has improved the prognosis of patients with pediatric malignancies over the past 20 years (Bleyer, 1990; Rivera, Pinkel, Simone, Hancock, & Crist, 1993), diagnosis and treatment are still significant stresses for children and their families (Stuber, 1995). Parents of pediatric cancer patients report experiencing psychological distress more frequently than control parents (Kazak et al., 1998). Indeed, the emotional, social, and financial stresses associated with their child's cancer may overwhelm parents' capacity to cope with a wide variety of issues, including marital relationships and job-related demands.

### Marital Adjustment

A child's cancer impacts parents' marital relationships in various ways (Grootenhuis & Last, 1997; Sheeran, Marvin, & Pianta, 1997). Some parents experience their marriage as reasonably satisfactory and their partners as supportive (Barbarin, Hughes, & Chesler, 1985; Kupst et al., 1984) and remain in a stable marital relationship (Kupst & Schulman, 1988). Some parents report improvements in their marital relationship during the course of the child's illness, including increased closeness (Koch, 1985), strengthened marital bonds (Koocher & O'Malley, 1981), discovering different values or attitudes, and positively re-evaluating their life goals (Eiser & Havermans, 1992; Grootenhuis & Last, 1997).

Other parents find that marital distress increases after diagnosis (Dahlquist, Czyzewski, & Jones, 1996; Dahlquist et al., 1993; Fife, Norton, & Groom, 1987; Hoekstra-Weebers, Jaspers, Kamps, & Klip, 1998). The findings on the negative impact of a child's chronic illness on the marriage suggest that while the divorce rate is not necessarily elevated in these families (Lansky, Cairns, Hassanein, Wehr, & Lowman, 1978), marital satisfaction significantly is lower (Hauenstein, 1990).

Barbarin et al. (1985) argued that marital difficulties would not be detected early in the course of the child's illness because both partners are focusing on the child's treatment and survival, not their marital difficulties. However, Dahlquist et al. (1993) found that approximately 25% of mothers and 28% of fathers reported significant marital distress around the time of diagnosis of their child's cancer, as compared to

16% incidence of marital distress for the general population at any given point in time. These levels of marital distress did not change over time (up to 20 months after diagnosis) in their longitudinal study (Dahlquist et al., 1996), but in other longitudinal studies, marital distress did increase over time (Fife et al., 1987; Hoekstra-Weebers et al., 1998). For example, compared parents' reactions at 12 months after diagnosis with the time immediately after diagnosis (Hoekstra-Weebers et al., 1998) included 62 fathers and 66 mothers, 43% of parents reported increased marital distress over time, while 29% of the fathers and 43% of the mothers reported no change and 26% of the fathers and 14% of the mothers indicated more marital satisfaction.

At six and 10 years after diagnosis, parents studied by Kupst and colleagues (1995) seemed to be coping well. However, parents in other studies complained about feelings of uncertainty and loneliness when surveyed about 8 years after cessation of treatment (Dongen-Melman et al., 1995). Thus, the data are unclear, although it is likely that marital adjustment of parents of pediatric cancer patients differs as a function of time after diagnosis.

Strategies that parents use to cope with the diagnosis of their child's cancer have been studied as a possible predictor of marital adjustment. Certain coping strategies, such as good communication (Kupst & Schulman, 1988) and being optimistic (Barbarin & Chesler, 1984), have been found to be associated with marital satisfaction, while emotion-focused coping has been found to be associated with marital distress (Hoekstra-Weebers et al., 1998). The findings, however, have not been consistent. In addition, some studies found discrepancy between spouses' coping strategies to be a significant predictor of marital distress (e.g., Hoekstra-Weebers et al., 1998), while other studies did not (e.g., Dahlquist et al., 1993).

Although studies have examined parental coping following the death of a child from cancer (Martinson, Davies, & McClowry, 1991; Sormanti & August, 1997), few studies have examined parents' marital adjustment after such a death (Martinson, McClowry, Davies, & Kuhlenskamp, 1994) and, again, the findings have been inconsistent. Some studies found a child's death to be associated with parents' marital

distress (Kaplan et al., 1976; Lansky et al., 1978); however, such distress has not been associated with increases in divorce rates up to three years after the death (Kaplan et al., 1976; Lansky et al., 1978). In Martinson et al.'s (1994) study, 25% of parents reported separation or divorce within seven to nine years after the death of their child. Either the death of their child or another problem in their relationship that existed before the child was diagnosed with cancer was a major factor contributing to their divorce. Thus, it has been suggested that marital adjustment over time in bereaved parents should be examined more closely (Martinson et al., 1994).

### Occupational Adjustment

A national study conducted for Fortune Magazine and John Hancock Financial Services estimated that one in five workers in the United States have some type of caregiving responsibility and over 75% of employee caregivers report conflicts between work and family duties (Marks, 1998; Lechner, 1991). In the case of childhood cancer, parents have reported difficulties with job performance, satisfaction, and interest attributed to their child's illness (Morrow, Carpenter, & Hoagland, 1984; Rao, Malhotra, & Marwaha, 1992). In order to provide care for the sick child, one parent often stays with the child during the periods of hospitalization and outpatient treatments, which is likely to conflict with work schedules. Indeed, 32% of fathers and 62% of mothers have reported conflict with work activities after the diagnosis of cancer in their child (Schuler et al., 1985).

Although several initiatives, including the Family Leave Act (FLA) and Employee Assistance Programs (EAP), were designed to help families cope with work- and health-related pressures (Lechner, 1991), the majority of work environments still have not organized to promote employees' ability to attend to family responsibilities by utilizing such programs (Glass & Estes, 1997) or only a few employers have offered in-depth, comprehensive programs to family caregivers ("To Help Working Caregivers," 1999). In addition, few data have been gathered to assess the effectiveness of these programs and no studies have examined the impact of a child's cancer on a parent's occupational situation.

In summary, existing studies suggest that issues in both marital and occupational adjustment among parents of children with cancer are important markers of such parents' psychological well-being, while few study has examined both issues simultaneously or has compared such issues between parents of living children and bereaved parents. The present study was designed to extend earlier findings to explore three specific aims: (a) to identify positive or negative impacts of a child's cancer on parents' marital and occupational adjustment; (b) to identify use of employee assistance programs among parents of pediatric cancer patients; and (c) to examine differences in marital and occupational adjustment between parents of living children and bereaved parents from pediatric cancer

#### Method

The potential subject pools were the parents of living children diagnosed and treated by the Pediatric Oncology Service at Children's Hospital at Strong, Rochester, NY, between January 1987 through December, 1998 and the parents of children who had died between January 1993 and December, 1998. We contacted the parents of every 5th child listed chronologically by date of diagnosis ( $N = 135$ ) and every death ( $N = 64$ ), and asked them to complete a questionnaire developed specifically for this study. The questionnaire consisted of background information (e.g., child's diagnosis, date of diagnosis and/or death, and respondent's relationship to the patient, age, and response date), family relationship-related items (five forced-choice and five open-ended questions), and job-related items (nine forced-choice and 12 open-ended questions). This report is based on responses from 50 (37%) parents of living children and 22 (34%) bereaved parents.

As reported in Table 1, the demographic and diagnostic characteristics of child patients are typical of childhood cancer patients in the U. S. The majority of respondents (89%) were mothers. Respondents in the bereaved group were older ( $M = 43.80$ ; range = 35 to 57 years old) than those in the living group ( $M = 40.26$ ; range = 28 to 52 years old),  $F(1, 68) = 5.72$ ,  $p < .05$ . The time between the response date and the child's death (bereaved group:  $M = 3.25$  year; range = 1 to 6 years) and the child's diagnosis date (living

group:  $M = 5.36$  years; range = 0 to 11 years) was shorter for the bereaved group,  $F(1, 65) = 8.71, p < .01$ . This difference was expected given the study design. Other items in Table 1 were not significantly different between the groups.

## Results

### Marital Adjustment (Table 2).

The responses to two items on marital satisfaction showed that parents in the living group rated their marital satisfaction before the child's diagnosis higher than parents in the bereaved group rated their marital satisfaction before the child's death,  $t(66) = 2.15, p < .05$ . Parents' level of marital satisfaction before diagnosis or death was highly correlated to that after diagnosis or death ( $r = .58, p < .001$ ). The level of marital satisfaction after diagnosis or death, however, was not different between groups. Furthermore, the changes in marital satisfaction from before to after diagnosis or death was not significantly different between groups,  $t(65) = 1.54, ns$ .

Parents' marital satisfaction after diagnosis or death was not associated with any demographic or diagnostic variables such as patient's gender and time since diagnosis or death with our small sample. Therefore, despite the literature regarding time since diagnosis or death, we have pooled the sample. Higher level of parental marital satisfaction after diagnosis or death was associated with three factors: (1) stable marital status ( $\beta = .27, p < .002$ ); (2) perception that the diagnosis or death had a positive impact on their marriage/relationship ( $\beta = .44, p < .001$ ); and (3) their higher marital satisfaction level before diagnosis or death ( $\beta = .38, p < .001$ ). About 10% of the parents' marital status changed after their child's diagnosis or death. Parents reported that the diagnosis or death of the child affected their marriage positively (53.0%: e.g., getting closer, having a new life view), negatively (18.2%: e.g., becoming distant, divorced/separated), both (9.1%), or not at all (19.7%).

Most respondents (67.2%) reported that each parent reacted in different ways to their child's

diagnosis or death. Mothers focused on and talked more about the diagnosis or death and were more likely to become emotional, whereas fathers tried to avoid the problem or internalize it. No items other than marital satisfaction before diagnosis or death were different between groups. Thus, averaged frequencies are reported in the text (separated frequencies for each group are reported in Table 2).

In making recommendations for services or programs to promote better marital adjustment for other parents in the same situation, parents in the study identified good communication between parents as the most important element, followed by working as a team, and having time to oneself. Literature or counseling to promote understanding that their spouse would cope with the situation differently was highly recommended for bereaved parents. Parents also suggested that psychosocial programs in pediatric oncology provide information about general marriage or family counseling, seminars, and educational support groups available through community agencies or privately.

#### Occupational Adjustment (Table 3).

The adjusted frequencies of responses to each item were not significantly different between groups and were not significantly related to demographic or diagnostic variables. Thus, average frequencies are reported in the text and separated frequencies are reported in Table 3.

The majority of parents were working outside the home at the time of the child's diagnosis (65.3% for respondents who were almost all mothers, 88.7% for spouse, 65.1% both worked). About half (56.9%) of the respondents left their job in order to care for their child with cancer. The major reason given for leaving their job was to manage the child's treatment. The parent more likely to leave a job was the one who worked part-time, made less money, or had fewer health insurance benefits.

Most parents reported that employers understood their need for time off and the reasons for other attendance or productivity problems around the time or after their child's diagnosis or death (57.7% for the respondent who voluntarily quit work early on, 81.7% for the spouse). Accommodation made by employers included flexible working hours, allowing work at home, and providing emotional/financial support. A few



parents' employers, however, did not allow time off or reprimanded the parent for taking time off.

About half (48.6%) of the respondents' job situation changed after diagnosis, while about one quarter (25.7%) of a respondent's spouse's job situation changed after diagnosis. Reasons for changing jobs included working more hours to make more money or reducing or terminating their job to have more flexibility in meeting the child's treatment schedule.

About 40% of parents made use of the Family Leave Act (FLA), 35% participated in their Employee Assistance Program (EAP), and 4.5% received help from their union. About 25% of parents were not aware of the EAP or FLA, which is relatively new program (instituted in 1993); 55% of parents did not belong to a union. These percentages are lower than the findings reported by Weinberg who surveyed employers of employed caregivers of terminally or critically ill family members, most of whom were adults ("To Help Working Caregivers," 1999). Weinberg found that 88% of employers reported offering bereavement leave to their employees and 60% offered family and medical leave to their employees. When a parent used the FLA program, the parent was more likely to use EAP programs ( $r = .43, p < .001$ ) or belong to a union ( $r = .29, p < .01$ ). When parents used any program to increase their availability to their child, they expressed satisfaction with the ability to take days off. Financial problems associated with days off without pay, however, were also reported.

In making recommendations for services or programs to promote better occupational adjustment for other parents in the same situation, parents in the study suggested that parents take the initiative to talk to others such as employers or social workers about their needs. In some situations, corroboration from the treatment center is useful, while most suggested that parents take time off to spend time with the patient and collect as much information as possible about job options (i.e., not being too precipitous in their decision-making about how to juggle work and family demands). Some suggested continuing to work to help maintain stability in life. Other parents suggested that psychosocial programs in pediatric oncology provide more financial information, especially about funds, foundations, and agencies. In addition, most of

the bereaved parents wanted psychosocial program staff to maintain consistent contact with them to provide emotional support, believing that this would help their occupational adjustment.

#### Relationship Between Marital Adjustment and Occupational Adjustment (Table 4).

In order to examine the relationship between marital adjustment and occupational adjustment, Kendall's tau correlational analyses were performed with dichotomous variables. Marital status change was positively correlated with the employer's understanding of the respondent's need for time off and other work-related problems. Differences in coping with the diagnosis or death between parents were positively correlated with respondent's working outside the home at the time of the child's diagnosis, respondent's leaving work in order to take care of the child with cancer, and a change in the spouse's job after the diagnosis or death. The perception that the child's diagnosis or death had a positive influence on the parents' marriage/relationship was positively correlated with the respondent's leaving work to care for the child with cancer. Parents' marital satisfaction before diagnosis or death was negatively correlated with both the respondent's working outside the home at the time of diagnosis and the respondent's leaving work to care for the child with cancer. Parents' marital satisfaction after diagnosis or death was not significantly related to any occupational satisfaction items.

In conclusion, although the findings from this small survey with about a 33% return rate must be interpreted conservatively, the results suggest that the child's diagnosis or death from cancer per se does not directly influence marital adjustment but the degree to which each partner perceives stress from the diagnosis or death may have differential impacts on marital adjustment. In addition, changes in job status attributed to the diagnosis or death of the child appear to be common, while making use of programs such as the FLA or EAP is rare.

### Discussion

#### Differences in Marital Adjustment between Parents of Living Children and Bereaved Parents

There was one significant group differences in marital adjustment variables. The level of marital

satisfaction before diagnosis or death was higher for the living group of parents than for the bereaved group of parents. This is likely the result of disappointment, anger, guilt, and other negative feelings that accompany poor prognosis, the need for more aggressive treatment, and anxiety about impending death.

#### Marital Satisfaction After Diagnosis or Death

Three variables were found to be significant predictors of marital satisfaction after diagnosis or death: stable marital status, perceived positive impact of diagnosis or death on their marriage, and a satisfactory marital relationship before diagnosis or death. No background or diagnostic variables or differences in coping were significant predictors of marital satisfaction after diagnosis or death. In addition, the changes in marital satisfaction were not significantly related to the linear function of time after the death (up to 6 years) or diagnosis (up to 11 years) in the present study, which is consistent with Dahlquist et al.'s (1996) and Kupst et al.'s (1995) findings. The changes in marital satisfaction were still not related to the time after diagnosis or death when the curvilinear function of time was examined.

Parents identified spousal cooperation in maintaining the marriage as a crucial protective factor against the stress of the child's cancer. Parents advised that good communication about each other's needs, understanding and patience about individual differences in coping, working as a team, and perceiving the event of diagnosis or death as an opportunity for individual growth as important for improving marital satisfaction. These findings are consistent with previous reports (Kupst & Schulman, 1988; Sutor & Pillemer, 1994).

#### Occupational Adjustment

There were no group differences in occupational adjustment items between the parents of living children group and the bereaved parents group. The results showed that half of parents had to leave their job to manage the logistics of their child's treatment. Most of those who quit were mothers, due to their traditional caregiving role, lower pay scale, or having fewer health insurance benefits than fathers. This was likely to put more financial burden on fathers who, thus, become not only the major, but also the sole,

breadwinner in the family. Most employers were reported to be supportive of parents' need for time off. Time off, however, is a double-edged sword: not only does it have a beneficial effect (greater flexibility and more time with the sick child and other family members), but it also increases financial strain. Clearly, more research is required to identify the types of employment policies that will be most helpful in reducing parents' caregiving-work conflicts and in preserving the integrity of the family unit.

Bereaved parents suggested that oncology staff have periodic contact with them after their child's death to support their general emotional and social adjustment as well as their occupational adjustment. This suggestion is consistent with Sormanti and August's (1997) finding that parents who experienced continuous connection to their dead child coped with bereavement better.

#### Relationship Between Marital and Occupational Adjustment

The findings in the present study showed that a parent's leaving a job after diagnosis or death was positively associated with both differences in coping styles within a couple and parents' perception of the child's illness as having a positive impact on their marriage. In addition, a parent's leaving a job after diagnosis or death was negatively associated with marital satisfaction before diagnosis or death. The results suggest that parental differences in coping with their child's cancer and lower level of marital satisfaction before diagnosis lead a parent to leave their job in order to manage the cancer-related disruption in their life. When one of the parents can leave his/her job, the couple is more likely to perceive their child's disease as having a positive effect on their marriage. The level of marital satisfaction after diagnosis or death, however, was not related to any occupational variables. It seems that marital adjustment after diagnosis or death is related more to supports or issues within the family than to supports or issues involving work.

The limitations of the present study include its cross-sectional design, the use of non-standardized questionnaires, responses from only one family member, the preponderance of respondents who were mothers, and reliance on recall. The findings on marital adjustment, in particular, reflect virtually only the

wives' own perspective. In addition, the low response rate (35%) can not be construed to be representative of the full range of potential effects that childhood cancer can have on parental adjustment. These limitations should be carefully considered in the design of future studies.

Longitudinal investigation of each partner's perceptions of the marital relationship will help clarify the effects of pediatric cancer on marital satisfaction and provide useful insight into how to effectively counsel couples prospectively. Our findings about occupational satisfaction suggest that educating parents and employers about available options in the workplace may help meet both the parents' personal needs and the employers' workload demands. Knowing more about how job satisfaction and marital satisfaction are related in catastrophic situations will be useful for developing educational and other intervention programs to improve parents' satisfaction with marriage and employment issues while they are coping with their child's illness.

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Table 1. Pediatric Cancer Patient and Survey Respondent Demographic and Diagnosis Information

	Living (N = 50)	Bereaved (N = 22)
<u>Patient</u>		
Male	59.1%	59.1%
Female	40.9%	40.9%
<u>Diagnosis</u>		
Leukemia	44.9%	23.3%
Brain Tumor	28.6%	47.6%
Lymphoma	14.3%	14.3%
Solid Tumor	12.2%	14.3%
<u>Respondent</u>		
Mother	96.0%	81.0%
Father	4.0%	19.0%
Age	40.26a (5.65)	43.80b (5.43)
Response Time <sup>1</sup>	5.36a (3.17)	3.25b (1.47)

Note: numbers in parentheses are SDs;

Response Time 1 = years since diagnosis for the living group, since death for the bereaved group

Table 2. . Marital Adjustment

	Living	Bereaved
Marital Satisfaction Before Diagnosis/Death (1 to 5=highest)	Wife (Husband)	Wife (Husband)
Marital Satisfaction After Diagnosis/Death (1 to 5=highest)	4.16 <sub>a</sub> (.80) 3.94 (1.09)	3.63 <sub>a</sub> (1.16) 3.94 (1.30)
Was There a Difference Between Parental Reactions to Diagnosis/Death: Yes	31 (62%)	14 (82%)
Did Marital Status Change Since Diagnosis/Death: Yes	6 (12%)	1 (5%)
How Did Child's Illness/Death Influence Marriage,		
Positively	26 (53%)	9 (53%)
Negatively	9 (18%)	3 (18%)
Both	5 (10%)	1 (6%)
Not At All	9 (18%)	4 (24%)
Spontaneous suggestions to other parents		
communication (sharing feelings)	31	7
have time to yourself	11	2
pray	7	3
work as a team	13	2
rely on others' help/counseling	6	3
be patient with each other	1	10
marriage or family counselor/seminar	7	5
refer families/groups	5	7
information on available programs	3	4
Spontaneous suggestions to psychosocial staff		

Note. Subscript a and b indicate the mean scores were different at  $p < .05$

Table 3. Occupational Satisfaction Items

	Living	Bereaved
Were YOU Working at the Time of Diagnosis:	Yes	77%
Was your SPOUSE Working at the Time of Diagnosis:	Yes	81%
Did You Leave Your Job to Provide Care:	Yes	64%
Who left work	Mother	53%
Did Your Employer Understand Need for Time Off:	Yes	68%
Did your Spouse's Employer Understand Need for Time Off:	Yes	82%

Table 4. Correlation Coefficients (Kendall's Tau) between Marital Adjustment and Occupational Satisfaction Items

Marital Variables	Occupational Variables			
	Worked	Left work	Spouse's Job Changed	My Employer Understood
Marital status change	.04	.09	-.09	.26*
Difference in ways of coping	.41***	.29*	.28*	.10
Positive Impact	-.16	-.30**	-.05	-.19
Pre-D Satisfaction	-.26*	-.31**	.03	-.15
Post-D Satisfaction	-.12	-.19	-.03	-.14

\*  $p < .05$

\*\*  $p < .01$

\*\*\*  $p < .001$

Note: Pre-D Satisfaction = Marital satisfaction before diagnosis or death;  
Post-D Satisfaction = Marital satisfaction after diagnosis or death

Depression in Spouses of People with Lung Cancer:  
Effects of Personality, Social Support, and Caregiving Burden

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Running Head: Caregiver Depression

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### Abstract

The relationship between personality characteristics and depression was examined in 120 older adult spouses of people with lung cancer. Social support and caregiving burden were proposed as mediators of the relationship between personality and depression. A series of Structural Equation Models (SEM) revealed that a direct path from the personality characteristics (high neuroticism, and low extraversion and self-efficacy) to depression in a model without the mediators was significant. In the proposed full model, personality was partially mediated by caregiving burden, as well as by the combination of social support and caregiving burden. Specifically, personality was associated with less social support and greater caregiving burden, which, in turn, was associated with a higher level of depression. These findings suggest that it is possible to identify spouses of cancer patients at risk for depression.

**Key Words:** caregiver depression, personality, social support, caregiving burden

## Depression in Spouses of People with Lung Cancer: Effects of Personality, Social Support, and Caregiving Burden

Severe illnesses, such as cancer, have a significant emotional impact upon individuals and their families (see for reviews, 1, 2). Among family members, spouses often serve as the primary caregivers for individuals with cancer (3-6). Investigating depression in spouses who provide care for cancer patients is important. If left untreated, depression can lead to functional impairments, poor perceived health, impaired quality of life, unnecessary healthcare utilization, physical morbidity, and premature mortality (7). Moreover, depression may also serve to diminish the quality and quantity of care provided by caregivers to their physically ill spouse (8, 9).

Spousal caregivers have reported high levels of depressive symptoms, similar to (e.g., 10) or even greater than those of the patients themselves (e.g., 11). For example, the average CES-D total scores among spouses of cancer patients has ranged from 7 (12) to 34 (3, 4). About 30% of spouses of cancer patients showed clinically significant levels of depression (13,14).

Although research on depression in spouses of older cancer patients is sparse, there is a substantial body of research on predictors of depression in spouses of frail elders, especially patients with mental disorders, and people with neurodegenerative diseases such as Alzheimer's Disease (e.g., 15,16). These studies suggest that depression in caregivers is associated with the caregiver's appraisal of the situation or resources rather than the patient's functional status (3,16-19, 20), underscoring the role of individual differences in caregiving, and raising important research questions. Who is



most likely to report depressive symptoms in the context of cancer caregiving? How do those depressive symptoms develop? Derived from personality research (21), self-efficacy theory (22-23), and stress and coping theory (24), our conceptual framework suggests that personality variables and stress-related variables (e.g. caregiving burden) operate in concert to amplify risk for depression. Specifically, based on prior research on personality and self-efficacy, we proposed that individuals high in neuroticism, low in extraversion, and low in self-efficacy would be most vulnerable to depression. Based on stress and coping models (24, 25), we also proposed that perceived social support and caregiving burden would mediate the relationship between indicators of personality, self-efficacy and vulnerability to depression.

This proposed conceptual framework was tested in a sample of spouses of people with lung cancer. It was estimated that in 2001 approximately 169,500 new cases of lung cancer would be diagnosed in the United States (26). Lung cancer is the third most common cancer and is the leading cause of cancer death for both sexes (26). The 1-year survival rates for lung cancer have increased from 34% in 1975 to 41% in 1996, largely due to improvements in surgical techniques. However, the 5-year survival rate for all stages combined is only 14% (26). The diagnosis, prognosis, and the physical symptoms of lung cancer are quite anxiety provoking to patients and family members (27). Thus, lung cancer caregiving is an interesting and potentially informative context within which to test our conceptual framework that is partially developed from literature in gerontology. Below, we elaborate on our framework and provide an empirical test of the hypothesized model.

### Caregiver's Personality and Depression

Whether or not individuals develop depressive symptoms in response to stressful situations is rather strongly determined by personality (28). A diathesis theory of depression (29) posits that individuals who are predisposed to depression are likely to become depressed in response to stressors, such as living with a gravely ill spouse. Three predispositions have been suggested to be particularly important: neuroticism, extraversion, and self-efficacy. Individuals high in neuroticism are more susceptible to sadness, anxiety, and self-consciousness and much more vulnerable to depression than are individuals low in neuroticism (30-33). Neuroticism has been associated with depression in spousal caregivers of patients with Alzheimer's disease and Parkinson's disease (15, 34), cardiovascular disease (17), in family caregivers of people with dementia (35), and in parental caregivers of patients with chronic mental disability (36). Moreover, neuroticism seems to be an important predictor of depression in spouses of cancer patients (5, 14, 37).

Individuals high in extraversion experience higher levels of positive affect, such as joy and happiness, and have higher levels of interest and engagement in social relationships, larger social networks, more frequent social contact, and higher levels of perceived social support than individuals who are less extraverted (38,39). They are also less vulnerable to depression than are individuals low in extraversion (32,33). Although extraversion has been rarely studied in the context of caregiving, one study of caregivers of cancer patients (5) showed that lower levels of extraversion were associated with higher levels of depression. Extraversion may be particularly salient in the caregiving context as people who are more extraverted may be more adept at recruiting and

mobilizing assistance, both from the social support network and from healthcare professionals.

Self-efficacy may also have important implications for the health consequences of caring for an ill family member (20, 40). Individuals high in self-efficacy report a higher sense of personal control and competence and more adequate support from close relationships (41, 42). Caregivers with high levels of self-efficacy report less strain and depression associated with caregiving than those low in self-efficacy (6, 20, 40, 43-45).

Thus, it seems reasonable to hypothesize that individuals who have these three dispositions (high neuroticism, low extraversion, low self-efficacy) may be more likely to be depressed when their spouse has cancer. The first hypothesis in the present study is that personality will have a direct effect on symptoms of depression in spouses of people with lung cancer.

#### Social Support and Caregiving Burden as Mediators

Although personality is an important determinant of health and psychological outcomes (46, 47), it is unclear how personality leads to these outcomes (48). How people cope with stressful experiences might play an important role in explaining the relation between personality and psychological outcomes (28, 48). The caregiving literature has understandably focused on stress and coping models and consequently emphasized the influence of caregiving burden and social support on outcomes such as depression in caregivers (e.g., 24), while ignoring potentially important personality traits (15). It is possible that the negative effects of poor social support and caregiving burden are attributable to personality traits but this has not been determined (25). By integrating the personality and the caregiving literatures and building on the pioneering

gerontological research of Hooker and colleagues (15), we propose a conceptual framework to understand depression associated with cancer caregiving. Specifically, we propose that perceived social support and caregiving burden will mediate the relationship between personality and depressive symptoms for spousal caregivers of individuals with lung cancer.

Attention to the role of social support within the caregiving process is growing (49). In general, the research shows that social support has a positive effect on health (50). In frail elderly individuals, the availability of social support and social contacts is an important determinant of the caregiver's well-being (51). Neuroticism, extraversion, and self-efficacy are each related to social support (5, 15, 17, 39). For example, among caregivers of cancer patients, individuals low in neuroticism, high in extraversion, and high in mastery (a construct similar to but not synonymous with self-efficacy) were more likely to consider the amount of social support provided as sufficient (5). Increases in social support during times of stress appear to reduce depression (e.g., 16, 19, 45, 52, 53). These findings suggest that social support might mediate the relationship between personality and depression.

Whereas social support appears to have salutary effects, caregiving burden may have negative effects on psychological outcomes of caregivers (3, 5, 15). Caregivers high in neuroticism, low in extraversion, or low in self-efficacy tend to experience higher levels of stress and caregiving burden (4, 5, 8, 15, 35). These findings suggest that caregiving burden might also mediate the relationship between personality and depression (15, 36). When caring for a spouse with cancer, individuals high in neuroticism may be less likely to develop positive coping strategies and more likely to

experience caregiving as burdensome, thus increasing their risk for depression. Extraverts, on the other hand, may be more able to reduce perceived caregiving burden because of their more optimistic outlook, higher levels of energy, and ability to recruit support, thus decreasing their risk for depression. Individuals high in self-efficacy may also feel more competent in providing caregiving (4) and, thus, may be less burdened by caregiving and less likely to experience psychological distress. The second hypothesis in the present study, depicted in Figure 1, is that the relation between personality and depression would be mediated by social support (hypothesis 2a), caregiving burden (hypothesis 2b), or a combination of the two (hypothesis 2c).

## Method

### Participants

One hundred and twenty spouses of lung cancer patients participated in the study. These individuals were part of a larger study entitled, "Personality and Responses to Life Events." Spouses who were married to someone who had been diagnosed with lung cancer within the past 5 years, over 18 years of age, and able to communicate verbally in English, were eligible for inclusion. The average age of the participants was 63.1 years (range 26 to 82: SD = 10.0), more than half were female (66%), and most were Caucasian (97%) and married to and living with the patients (98%). The mean level of education was 13.0 years. Stages of cancer in the participants' partners were: Stage I (47%), II (12%), III (25%), and IV (16%). The patients underwent surgery (56%), a combination of surgery, radiation, and chemotherapy (35%), radiation only (6%), or chemotherapy only (3%) as cancer treatment. Over three-quarters of the patients (79%) had completed treatment when their spouses participated in the study.

### Procedure

A member of our research team, based in the Department of Psychiatry, identified eligible spouses. In general, the treating surgeon or oncologist introduced the research assistant to the spouse. The research assistant then explained the nature of the study and invited the spouse to participate. Informed consent was obtained at the time of interview using a consent form approved by the Research Subjects Review Board at the University of Rochester. Most of the interviews lasted between 2 and 3 hours. Master's level research assistants administered the self-report questionnaires and conducted interviews after extensive training in structured interviewing. Training sessions were conducted throughout the study to maintain acceptable interviewer consistency, monitor rater drift, and ensure the methodological integrity of the data collection process.

### Measures

Personality. There were three indicators of personality: neuroticism, extraversion, and self-efficacy. Neuroticism and extraversion were measured via 12 internally consistent items ( $\alpha = .84, .63$ , respectively, in the current study) from the NEO-FFI (38), using a 5-point Likert response format (1 = strongly disagree, and 5 = strongly agree). Individuals high in neuroticism are characterized as worrying, nervous, emotional, insecure, inadequate, and hypochondriacal (21). Individuals high in extraversion are characterized as joyful, energetic, and dominant (21). People who obtain low extraversion scores are relatively shy and reclusive, and may have social skill deficits (39). The NEO-FFI has been validated (38), and its use in research in gerontology (e.g., 13,34,54) attests to its reliability and applicability to samples of older adults.

The third measure was interpersonal self-efficacy, a subscale of the Self-Efficacy

Scale (55), assessed by 5 internally consistent items ( $\alpha = .80$  in the current study) using a 4-point Likert response format (1 = strongly disagree, and 4 = strongly agree).

Individuals high on interpersonal self-efficacy are characterized as being effective in dealing with spouse, family, and friends (55). The validity of the scale has been documented (55, 56).

Social Support. The abbreviated 19-item version of the Duke Social Support Index (57) was used to assess three dimensions of social support: instrumental support (6 items), perceived social support (12 items), and satisfaction with social support (1 item), using a 3-point Likert response format (1 = hardly ever, 3 = most of the time). The scale has been validated in mixed age samples (57). Although spousal support has been studied most frequently (e.g., 58), other sources such as adult children and friends may also be important (52). Thus, consistent with suggestions (e.g., 59-62), we asked participants to complete each item three times, in reference to (a) spouse, (b) children, and (c) close family and friends. The scores across dimensions (instrumental, perceived, satisfaction) of social support were averaged per source of social support and labeled spouse, child, and friend. Because the three dimensions of social support for each support person tapped different domains, calculating internal consistency across dimensions was not appropriate in this instance (see 63). Instead we used confirmatory factor analysis to demonstrate reliability (see Results section under sub-title, "Evaluating the Measurement Model"). Nevertheless, use of a total cumulative score is appropriate to indicate overall supportiveness of each source of support.

Caregiving Burden. The 18-item Burden Interview (BI) was used to assess the stresses and amount of perceived burden experienced by caregivers (64, 65), using a 5-

point Likert response format (1 = never, 5 = nearly always). The measure has two subscales: personal strain, which refers to how personally stressful the experience is (12 items), and role strain, which refers to stress due to role conflict or overload (6 items). The scale has been validated with elderly cancer patients, their primary caregiving spouses, and their adult children (66). Each subscale score was determined by summing the responses of relevant items, with higher scores indicating more caregiver distress. Both subscales have good internal consistency in the current study ( $\alpha = .80, .87$ , personal and role strain, respectively).

Depression. The 20-item Center for Epidemiologic Studies Depression Index (CES-D: 67) was used to measure the overall level of depression experienced more days than not in the past week, using a 4-point Likert response format (0 = rarely or none of the time, 3 = most or all of time). This measure has been used with older adults (e.g., 68) as well as spouse caregivers (e.g., 69), and found to have good reliability and validity ( $\alpha = .92$  in the current study).

Depression in the present study was also assessed using the 24-item observer-rated Hamilton Depression Rating Scale (Ham-D; 70). The Ham-D is a structured assessment of the presence and severity of depressive symptoms in the week prior to interview, including depressed mood, loss of interest, sleep disturbance, suicidal ideation, worthlessness, somatic complaints, helplessness, hopelessness, and fatigue. This measure was administered by a trained clinical interviewer. Scores are based in part on self-report, as well as on nonverbal presentation. For example, if a respondent denies that he or she is feeling sad, but this is contradicted by his or her facial expression, then the examiner might rate the person as mildly sad. Higher Ham-D scores reflect greater



depressive symptoms. The Ham-D had acceptable inter-rater correlation (.72 in the current study) and has well-established reliability and validity (71, 72).

## Results

Descriptive statistics (means and standard deviations) of study variables are reported in Table 1. The mean of the sum of personal and role strain which were subscales in the Burden Interview was 31.33 (range 18 to 60), indicating that the participants in the study were mildly to moderately burdened (65). The average CES-D score in this study was 11.3, which was higher than the population average (between 8 and 9: 73).

The patient's stage of cancer was included as a covariate in all subsequent analyses. Zero-order correlations among the variables included in the study model are reported in Table 2.

### Hypotheses Testing

Model Specification. Measurement properties of four proposed latent variables in the current study (see Figure 1) were examined utilizing structural equation modeling (AMOS 4.0: 74). The model parameters with observed variables were specified as follows: the personality latent variable was measured by neuroticism, extraversion, and interpersonal self-efficacy; the social support latent variable was measured by perceived support from spouse, child, and friend; the caregiving burden latent variable was measured by personal strain and role strain; and the depression latent variable was measured by CES-D and Ham-D scores. In addition, the patient's stage of cancer was included as a covariate. (Figure 2).

The model parameters were specified as follows: the observed variables for each

relevant latent variable were specified not to have a zero loading on the relevant latent factor while the loadings on all other latent factors were constrained to equal zero. For example, neuroticism, extraversion, and interpersonal self-efficacy measures were specified not to have a zero loading on the personality latent factor while the loadings on all other latent factors (i.e., social support, caregiving burden, and depression) were constrained to equal zero. All off-diagonal elements in the measurement error matrices were fixed to zero, thus measurement error variances were not allowed to be correlated each other.

Second, in order to test the predicted mediating effects of social support and/or caregiving burden, the structural component of the model was specified as follows: paths from exogenous variable (i.e., personality) to endogenous variables (i.e., social support, caregiving burden, and depression) were specified as free parameters to be estimated with current data. These paths will provide the information on the direct effects from personality to social support, caregiving burden, and depression. The paths from social support to either caregiving burden or depression and from caregiving burden to depression were also specified as free to be estimated. These paths will provide the information on mediating effects of social support and/or caregiving burden in the link between personality and depression. All other paths were constrained to zero. All errors in equations for the endogenous variables were specified as free to be estimated. AMOS employs maximum likelihood (ML) methods to estimate free parameters (74). All path coefficients reported in Table 3 and Figure 2 were completely standardized.

The following four model fit indices were used in the current study: the chi-square, the goodness of fit index (GFI), the confirmatory fit index (CFI), and the root

mean squared error of approximation (RMSEA). For the chi-square, less than two times of degree-of-freedom, for the GFI and the CFI, values of  $> .9$ , and for the RMSEA measure, values of  $< .08$  (75), reflect adequate fits of a specified model to the data (76).

Evaluating the Measurement Model. A confirmatory factor analysis using a structural equation model established that all three personality measures loaded on the personality construct significantly. Standardized regression loadings for the latent factor of personality for each of the three measures were all significant as follows: .76 (neuroticism), -.49 (extraversion), and -.59 (interpersonal self-efficacy),  $p < .001$ . Thus, high scores on the personality latent variable indicate a combination of neuroticism, introversion, and lack of perceived interpersonal competence.

The other three latent variables were also measured satisfactorily ( $p < .001$ ). The social support latent variable was loaded by three sources: spouse ( $\beta = .61$ ), child ( $\beta = .90$ ), and friend ( $\beta = .81$ ), indicating that all were equally important and adequate measures of the latent variable. The caregiving burden latent variable was loaded by personal strain ( $\beta = .83$ ) and role strain ( $\beta = .90$ ), supporting the presumed psychometric properties of the Burden Interview scale. The depression latent variable was loaded by the self-report measure of CES-D ( $\beta = .80$ ) and the observer rating score of Ham-D ( $\beta = .84$ ). In sum, each of the four latent variables was assessed with appropriate manifest indicators.

Evaluating the Model Structure. First, hypothesis 1 that caregivers' personality would directly predict their depression was tested. Thus, the model tested included the exogenous variable of personality and an endogenous variable of depression. The fit of the specified model was satisfactory, after allowing an

additional error term between neuroticism and interpersonal self-efficacy to be correlated to improve the model fit,  $\chi^2_{(7)} = 11.9$ , GFI = .97, CFI = .97, and RMSEA = .08. The path from personality to depression was significant, indicating that personality predicted depression directly ( $\beta = .70$ ,  $p < .001$ ).

Hypotheses 2 (2a to 2c), which stated that caregivers' personality would indirectly predict their depression via social support and/or caregiving burden, were examined simultaneously (see the column under "study model" in Table 3). For the model depicted in Figure 2, the fit was acceptable,  $\chi^2_{(37)} = 65.24$ , GFI = .92, CFI = .94, and RMSEA = .08. As shown in Table 3, the magnitude of the direct path from personality to depression was reduced, but remained significant when the proposed mediators were entered indicating that there are significant unique effects of personality as well as significant contributions by the proposed mediators. The significant path from personality to social support indicates that individuals with higher neuroticism scores, lower extraversion scores, and lower interpersonal self-efficacy scores were less likely to believe that support was available from their spouse, adult children, or friends.

However, contrary to hypothesis 2a, social support did not have a direct relation to depression. Rather, personality predicted social support, and in turn the effect of social support on depression was mediated by caregiving burden. Thus, individuals who scored high in neuroticism, low in extraversion, and low in self-efficacy, were more likely to report lower levels of social support, consequently experienced greater caregiving burden, which brought about higher levels of depression. This pattern supported hypothesis 2c. The path from personality to

depression also was mediated by caregiving burden alone, indicating that people with high neuroticism, low extraversion, and low self-efficacy were more likely to experience caregiving as more burdensome, which in turn, was related to their higher level of depression. This pattern supported hypothesis 2b.

### Supplementary Analyses

Two competing models were compared with the proposed model in the study, in order to (a) examine the significant contribution of self-efficacy as a personality component in addition to neuroticism and extraversion (NE Model) and (b) to rule out bias in the relationship of neuroticism and depression due to shared method variance of self-report measurement between the two constructs (HAM model).

To test the NE model, the personality latent variable was measured with neuroticism and extraversion, but not self-efficacy. All other latent variables remained the same as those in the proposed model in the study. The fit of the NE model was satisfactory,  $\chi^2_{(29)} = 47.00$ , GFI = .93, CFI = .96, and RMSEA = .07, and it was significantly different from the study model,  $\chi^2_{\text{diff}(8)} = 18.25$ ,  $p < .05$ . In the NE model (see the column under “NE model” in Table 3), personality predicted depression directly as well as indirectly via social support and caregiving burden. The paths from personality to depression, from personality to social support, from social support to caregiving burden, and from caregiving burden to depression remained significant. The path from social support to depression remained nonsignificant. However, the path from personality to caregiving burden became nonsignificant. The NE model suggests that individual differences in efficacy in interpersonal relationships may be an important predictor of caregiver burden.

The HAM model excluded CES-D from the depression latent variable and included only the Hamilton Depression Rating. All other latent variables remained the same as those in the proposed study model. The fit of the HAM model was also satisfactory,  $\chi^2_{(29)} = 53.44$ , GFI = .92, CFI = .94, and RMSEA = .08, but was not significantly different from the proposed study model,  $\chi^2_{\text{diff}(8)} = 11.81$ ,  $p > .10$ . In this model as shown in Table 3, the paths from personality to depression, from personality to social support, from social support to caregiving burden, from caregiving burden to depression, and from personality to caregiving burden all remained significant. The path from social support to depression remained nonsignificant. Personality predicted depression directly as well as indirectly via social support and/or caregiving burden. The HAM model suggests that the findings from the study model were not biased by the use of self-report measures for both personality and depression, and also that the observer ratings of depression were congruent with self-report of depression.

The results from the two competing model tests suggest that interpersonal self-efficacy is a significant personality component in the proposed conceptual model and support that the study model is valid not only with self-report measures of depression but also observer-rated depression.

Finally, another model was tested to examine the role of social support on depression, excluding the personality factor. This model included social support, caregiving burden, and depression latent variables. When only social support and depression were included in the model, the direct path from social support to depression was significant ( $\beta = -.43$ ,  $p < .001$ ),  $\chi^2_{(8)} = 8.43$ , GFI = .98, CFI = .99, and RMSEA = .02. When caregiving burden was added into the model, the path from social support to

depression became marginally significant ( $\beta = -.20$ ,  $p < .07$ ),  $\chi^2_{(17)} = 27.11$ , GFI = .95, CFI = .97, and RMSEA = .07. The results indicate that the impact of social support on depression is fully mediated by caregiving burden.

### Discussion

Personality predicted depression in spouses of people with lung cancer in the present study, which is consistent with theory and research on personality (e.g., 21, 48), stress and coping (e.g., 24), and caregiving (e.g., 3, 15). With one exception (hypothesis 2a) results support the two study hypotheses, demonstrating that personality characteristics were associated with a higher level of depression directly (hypothesis 1) and indirectly through lower levels of social support and increased caregiving burden (hypotheses 2b and 2c). In addition to neuroticism, which has been studied extensively (e.g., 5, 15, 17), two other personality dimensions, extraversion (e.g., 5, 32) and interpersonal self-efficacy (e.g., 40, 43) add predictive value to the conceptual model proposed in the present study and confirm existing findings (5, 43). The study model is valid not only with self-report measures of depression but also with observer-rated depression, which significantly increases our confidence in the results.

In addition, the hypothesized relationship between personality and depression was also partially mediated by social support and caregiving burden. High neuroticism, low extraversion, and low interpersonal self-efficacy limited caregivers' available social support. This in turn was associated with a greater degree of experienced personal and role strains. This finding increases our understanding of how depressive symptoms may develop in the cancer caregiving context.

Interestingly, it appears that the relationship between social support and depression is rather complicated in this context. Although social support alone was a significant predictor of depression in a supplementary analysis, this direct relationship was no longer statistically significant when personality was included in the model, which is consistent with previous research (15). It appears that the association between depression and one's perception of and satisfaction with social support relies heavily on individual differences in personality. In other words, social support may be a highly overlapping construct with personality (neuroticism, extraversion, and interpersonal self-efficacy) in the caregiving context. Thus, when the effects of these constructs were examined simultaneously, social support was no longer significant.

Consistent with other caregiving research (3, 15, 77), caregiving burden by itself was a significant and direct correlate of depressive symptoms. Furthermore, caregiving burden fully mediated the modest effect of social support on depression. In other words, after controlling for the effect of caregiving burden on depression, social support by itself was not a significant predictor of depression. Future studies exploring the health effects of social support may need to consider both plausible antecedents (i.e., personality) and mechanisms (i.e., reduced caregiving burden).

Limitations in the present study design and interpretation of the findings should not be overlooked. First, the current study used only spousal reports. Patient characteristics such as personality, social support seeking and receiving styles, and level of depression are also associated with caregivers' psychological and physical outcomes (3, 4, 78). In addition, the quality of the relationship (see 79 for a review) between the patient and the spouse may be a significant contributor to understanding the



consequences of caregiving. For example, risk of developing depressive symptoms increased 10-fold (80) or 25-fold (81) when marital discord was present. Types of relationship (e.g., communal versus non-communal relationship) also have differential influences on the consequences of caregiving (82).

Second, our sample was not large enough to test whether the model would differ for men and women (see 83). Future studies with a larger sample are needed to examine if the current framework holds within each gender. Third, the cross-sectional design of the present study prevents the inference of causal relations among study variables. Caregiving is a dynamic, ongoing process, for which several trajectories have been proposed (49, 73). For example, it is possible that caregiving burden represents an important factor in exacerbating caregiver depression during cancer treatment and shortly after treatments end, but not over a longer period, after the spouse accommodates to the burden. There may be an overflow of social support to the patients and the family during the peri-diagnostic period, but a withdrawal of social support afterwards. The individual's psychological resources then may be more critical when social support diminishes. Fourth, we studied a homogenous group of spouses of people with lung cancer who were mostly Caucasian. African-American caregivers have been found to adjust better in dealing with caregiving responsibilities, experience less depression, and greater satisfaction in the caregiving role than do their Caucasian counterparts (84, 85). Adult daughters who provide care for parents with cancer have also shown a higher level of depressive symptoms (77). Replicating the current findings with groups of caregivers from different disease, racial or social groups will enrich the proposed model in the present study. Finally, although both negative and positive emotional reactions to giving

care to seriously ill patients have been documented (83, 86), we did not examine the potential positive outcomes of caregiving, such as growth experience (43).

Despite these limitations, the present study has significant implications for theory surrounding cancer caregiving and stress, and for practical interventions with cancer caregivers. From a theoretical perspective, it is important to understand depression in cancer caregivers using both personality and stress-coping models, because consequences of cancer caregiving depend on a dynamic process between the longstanding personality traits of the caregivers and the specific coping processes utilized in stressful situations (28, 49).

From a pragmatic perspective, the findings of the present study suggest that it is possible to identify vulnerable caregivers by virtue of their personality traits. Caregivers high in neuroticism may suffer more from the adverse stress effects of providing care for an ill spouse, while caregivers high in extraversion and interpersonal self-efficacy may be more resilient. In addition, intervention programs targeted at maximizing social support and minimizing caregiving burden hold promise for promoting cancer caregiver's mental health. For instance, interventions that modify the caregivers' perception and satisfaction with social support could alleviate perceived caregiving burden, and may in turn help to alleviate or prevent depression. In addition, interventions that emphasize education and information about medical treatment and disease processes (19, 87), focus on improving problem solving skills (88), and provide respite services such as adult day care or sitter services (19) appear to reduce caregiving burden. These interventions may in turn reduce depression (89).

Overall, the findings imply that spousal caregivers who are identified as having psychological characteristics that amplify risk for depression in the context of caregiving (high neuroticism, low extraversion, and low interpersonal self-efficacy) can be targeted early on for interventions designed to lessen depressive symptoms and thereby improve the quality of care that they provide to their ill spouses (82). Caregiver burnout or attrition can be a serious problem when the illness has a prolonged and stressful course, as is the case with many types of cancer (5, 77, 90). Knowledge of potential risks and protective factors associated with cancer caregiving is essential to enhancing the ability of caregivers to provide quality care to people with cancer as well as the well-being of the caregivers themselves.

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Table 1. Descriptive Information on Study Variables

	Mean	SD	Range
<u>Personality Traits</u>			
Neuroticism	29.37	6.81	15.00 – 53.00
Extraversion	39.00	4.92	25.00 – 49.00
Interpersonal Self Efficacy	12.43	2.02	7.00 – 16.00
<u>Social Support</u>			
Spouse <sup>a</sup>	10.98	.89	5.00 – 13.00
Children <sup>b</sup>	11.38	1.14	4.67 – 13.07
Friend <sup>c</sup>	11.89	1.16	5.00 – 14.67
<u>Caregiving Burden</u>			
Personal strain	21.60	6.08	12.00 – 37.00
Role strain	9.73	3.98	6.00 – 25.00
<u>Depression</u>			
CES-D <sup>d</sup>	11.31	9.11	0 – 40.00
Ham-D <sup>e</sup>	8.09	6.38	0 – 26.00

Note: <sup>a</sup> Spouse = Spouse's Social Support;

<sup>b</sup> Children = Children's Social Support;

<sup>c</sup> Friend = Friend's Social Support;

<sup>d</sup> CES-D = Center for Epidemiologic Studies Depression Index;

<sup>e</sup> Ham-D = Hamilton Depression Rating Scale

Table 2. Zero-order Correlations Between Variables Included in the Structural Models

	1	2	3	4	5	6	7	8	9	10	11
1. Neuroticism	-										
2. Extraversion	-.39***	-									
3. Interpersonal SE <sup>a</sup>	-.20*	.27**	-								
4. Spouse <sup>b</sup>	-.21*	.05	.16+	-							
5. Children <sup>c</sup>	-.18*	.12	.20*	.54***	-						
6. Friend <sup>d</sup>	-.17+	.06	.06	.49***	.73***	-					
7. Personal strain	.15+	-.09	-.38***	-.21*	-.35**	-.41***	-				
8. Role strain	.12	-.18*	-.40***	-.25**	-.44**	-.38***	.74***	-			
9. CES-D <sup>e</sup>	.52***	-.28**	-.34***	-.26**	-.26**	-.22*	.39**	.41***	-		
10. Ham-D <sup>f</sup>	.39***	-.30***	-.37***	-.39***	-.37***	-.30***	.49***	.52***	.67***	-	
11. Stage of Cancer	.21*	-.11	-.13	.02	.00	-.08	.26**	.13	.20*	.29***	-

+ p &lt; .10

\* p &lt; .05

\*\* p &lt; .01

\*\*\* p &lt; .001

Note: <sup>a</sup> Interpersonal SE = Interpersonal Self-Efficacy;<sup>b</sup> Spouse = Spouse's Social Support;<sup>c</sup> Children = Children's Social Support;<sup>d</sup> Friend = Friend's Social Support;<sup>e</sup> CES-D = Center for Epidemiologic Studies Depression Index;<sup>f</sup> Ham-D = Hamilton Depression Rating Scale

Table 3. Standardized Estimates of Direct Effects

	Study Model	NE Model	HAM Model
Personality → Social Support	-.29*	-.27*	-.29*
Personality → Caregiving Burden	.27*	.08	.30*
Personality → Depression	.52**	.55***	.53*
Social Support → Caregiving Burden	-.44***	-.50***	-.43***
Social Support → Depression	-.12	-.06	-.22
Caregiving Burden → Depression	.36**	.48***	.47**
Stage of Cancer → Depression	.14	.14	.23*

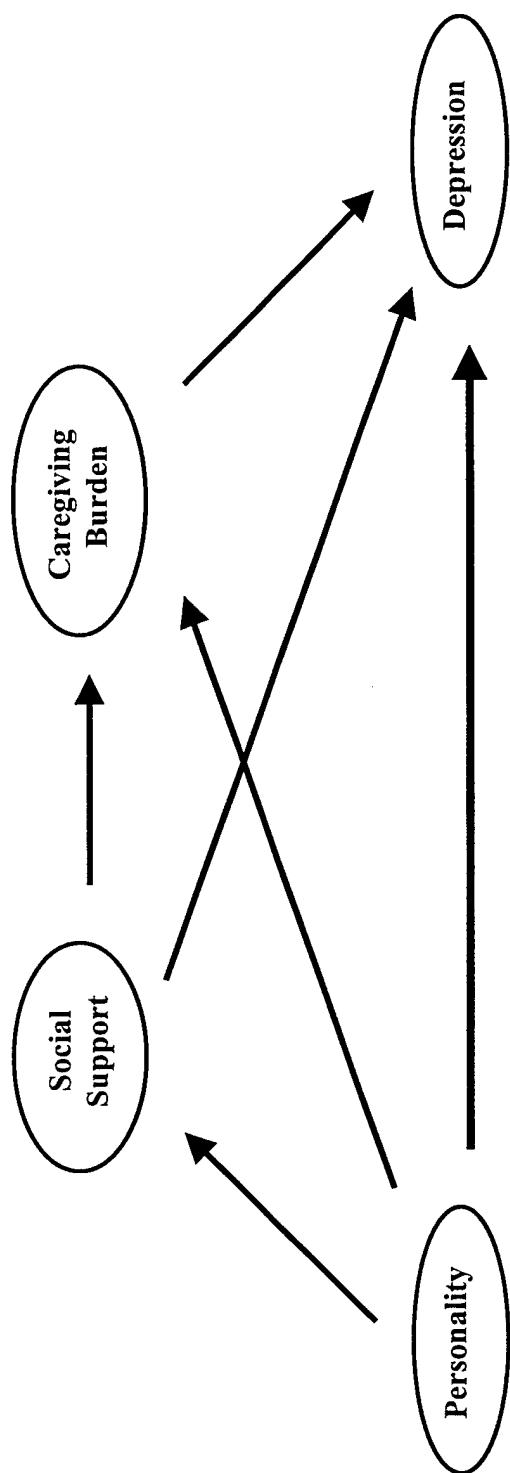
\*  $p < .05$ \*\*  $p < .01$ \*\*\*  $p < .001$ 

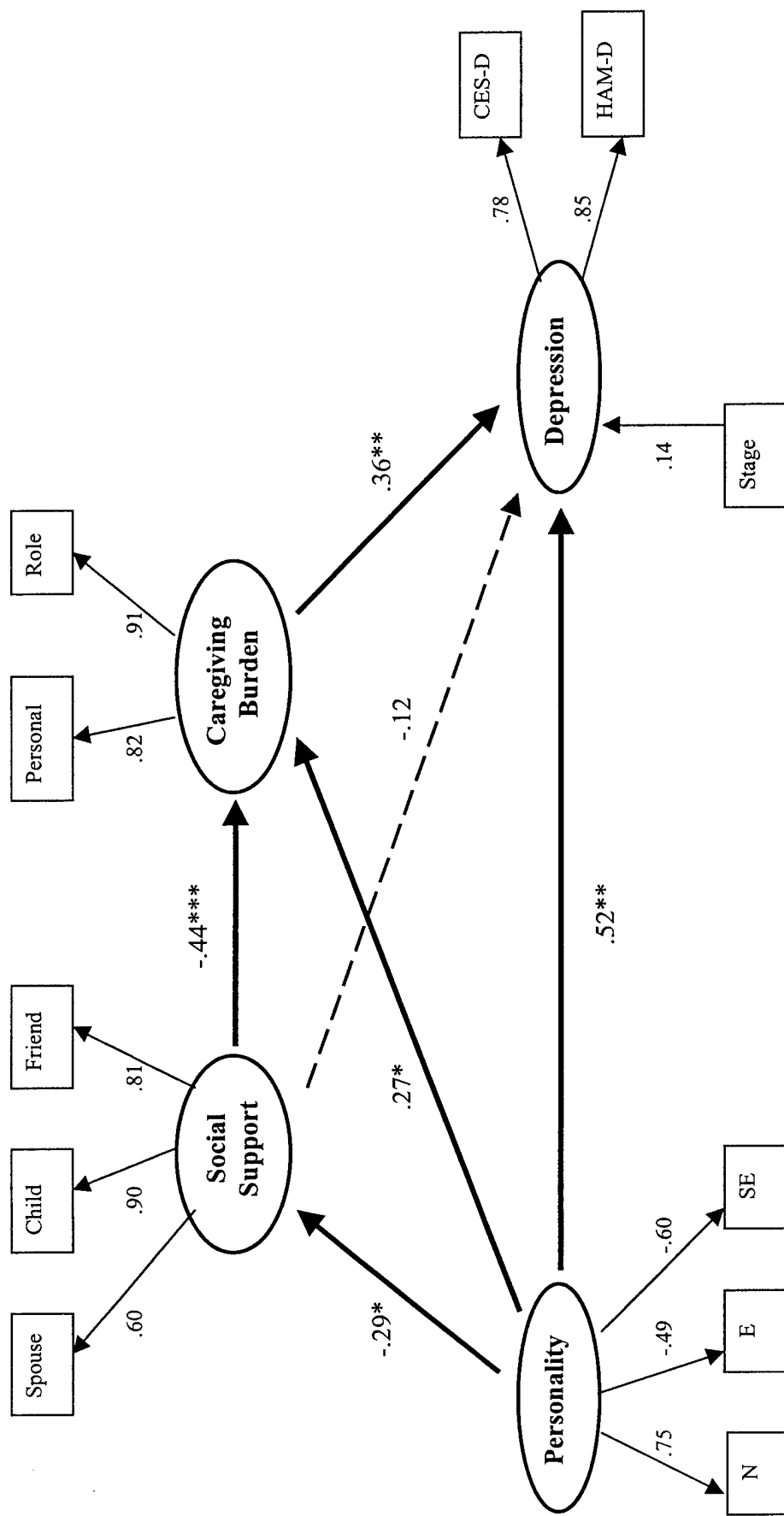
Note: Both NE and HAM models were supplementary models for comparing with the study model (see text for model specification)

## Figure Labels

Figure 1. Structural Model

Figure 2. Measurement Model





Note: N = Neuroticism; E = Extraversion; SE = Self-Efficacy; CES-D = Center for Epidemiologic Studies Depression Index; HAM-D = Hamilton Depression Rating Scale; Gender, 1 for females, 2 for males; All factor loadings, except from stage to depression, were significant at  $p < .001$ ; \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

The Effects of Family Support, Anxiety, and Post-Treatment Nausea  
on the Development of Anticipatory Nausea:  
A Latent Growth Structural Model

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### Abstract

Nausea is one of the most frequent side effects of chemotherapy for cancer. Although the degree of a patient's anxiety and symptoms of post-treatment nausea have been suggested as predictors of anticipatory nausea, little attention has been given to the impact of family support on the development of anticipatory nausea. This study examines the role of family support in the development of severity and duration of anticipatory nausea symptoms, both directly and mediated through a patient's anxiety or post-treatment nausea. Five hundred forty patients with breast cancer were studied. The results from latent growth structural modeling showed that family support had indirect impact on the levels of severity and duration of anticipatory nausea through the patient's anxiety and symptoms of post-treatment nausea. Specifically, supportive family environment is related to a reduced level of patient anxiety, which, in turn, inhibits development of symptoms of post-treatment nausea. This, in turn, inhibits development of anticipatory nausea symptoms. In a parallel finding, the family support had direct impact on the development of anticipatory nausea symptoms. This result indicates that supportive family environment is related to a patient's reduced level of anticipatory nausea independent of the impact of anxiety and post-treatment nausea. The findings imply that at the early stage of treatment, helping patients and their families communicate in more satisfactory and supportive ways and maintaining an organized family system would be beneficial in reducing the patient's anxiety and symptoms of chemotherapy-related nausea during cancer treatment.

**Key Words:** family support, anxiety, development of chemotherapy-related nausea, anticipatory nausea



## The Effects of Family Support, Anxiety, and Post-Treatment Nausea on the Development of Anticipatory Nausea: A Latent Growth Structural Model

Nausea, a subjective, unpleasant feeling that may trigger vomiting, is one of the most frequently reported and troublesome adverse effects of chemotherapy for cancer (Morrow, Roscoe, & Hickok, 1998). Chemotherapy-related nausea detracts significantly from a patient's quality of life and may even lead to a discontinuation or avoidance of treatments (Newell, Sanson-Fisher, Girgis, & Bonaventura, 1998). Post-treatment nausea is assumed to have pharmacological as well as psychological causes, whereas anticipatory nausea is assumed to be a conditioned response that is psychological in origin (Andrykowski & Jacobsen, 1993; Cameron et al., 2001; Morrow et al., 1998; Tomoyasu, Bovbjerg, & Jacobsen, 1996). Despite the use of increasingly potent antiemetic medications, such as 5-HT<sub>3</sub> receptor antagonists, the prevalence of nausea remains high (Morrow & Roscoe, 1998). Exploring psychological contributions to chemotherapy-related nausea, particularly to anticipatory nausea, may give hope that non-pharmacological or psychological methods to relieve the symptoms are efficacious.

Experiencing symptoms of post-treatment nausea has been assumed to be a necessary factor in the association (conditioning) process of development of anticipatory nausea (Andrykowski & Jacobsen, 1993; Tomoyasu, Bovbjerg, & Jacobsen, 1996). In addition, researchers have given much attention to anxiety as a significant psychological predictor of anticipatory nausea. It has been found that anxiety predisposes some individuals to learn quickly the association between certain stimuli and the drug-induced side-effects of post-treatment nausea, thereby contributing to the conditioned response of

anticipatory nausea (Andrykowski, 1990; Jacobsen, Bovbjerg, & Redd, 1993; Morrow, Roscoe, Kirshner, Hynes, & Rosenbluth, 1998). However, psychosocial predictors of the development of a patient's anxiety and the associated chemotherapy-related nausea across infusions have been given relatively little attention.

A plethora of studies has shown that social support plays a beneficial role in a patient's psychological and physical adjustment to various diseases including cancer (for review, see Cohen & Herbert, 1996; Spiegel & Kato, 1996). Among the several forms of social support, family support has been found to be the most important resource in a patient's adjustment to cancer (Fobair & Zabora, 1995; Lewis, Hammond, & Woods, 1993). Family support is generally viewed as the degree to which family members relate to and communicate with each other, pursue goals, organize activities, and perform family routines and procedures (Moos & Moos, 1986).

A number of studies have found that a patient's psychological adjustment to cancer is better in a family characterized by cohesiveness, open expression, and absence of conflict (Carter & Carter, 1993; Fobair & Zabora, 1995; Friedman, Baer, Nelson, Lane, Smith, & Dworkin, 1988; Friedman, Lehane, Webb, Weinberg, & Cooper, 1994; Koopman, Hermanson, Diamond, Angell, & Spiegel, 1998; Mesters, van den Borne, McCormick, Pruyn, deBoer, & Imnos, 1997; Molassiotis, van den Akker, & Boughton, 1997; Northouse, 1995; Spiegel, Bloom, & Gottheil, 1983). These family characteristics have been negatively associated with a patient's anxiety (e.g., Friedman et al., 1994; Koopman et al., 1998). Such family characteristics have also been associated with reduced chemotherapy-related symptoms, including fatigue and nausea (Bloom, 1982; Friedman et al., 1988; Friedman et al., 1994; Jamison, Burish, & Wallston, 1987; Mesters

et al., 1997; Peters-Golden, 1982; Spiegel, Bloom, & Gottheil, 1983; Williams, 1989). In addition to these family relationship characteristics, the family system, such as role flexibility and how the family is structured (Moos & Moos, 1986), has also influenced the patient's ability to adapt to the demands of cancer and its treatment (Williams, 1989).

The results from these studies suggest that the characteristics of family relationships and the family system are associated with the patient's psychological and physical adjustment, such as anxiety and chemotherapy-related nausea. As stated above, several studies examined the impact of family support on reducing a patient's anxiety (e.g., Friedman et al., 1994; Koopman et al., 1998; Northouse, 1995); the impact of a patient's anxiety on increasing symptoms of post-treatment nausea (e.g., Andrykowski, 1990; Jacobsen et al., 1993; Morrow, Roscoe, Kirshner et al., 1998); and the impact of symptoms of post-treatment nausea on increasing symptoms of anticipatory nausea (e.g., Andrykowski & Jacobsen, 1993; Tomoyasu et al., 1996). However, none of these studies has examined the associations among these factors in a simultaneous and longitudinal model. Thus, to date, no study has examined how family relationships and the family system facilitate or inhibit the development of a patient's symptoms of anticipatory nausea in a more complete model that includes the development of the patient's anxiety and symptoms of post-treatment nausea.

The prospective design in the current study allows us to examine predictors of development of anticipatory nausea. The model tested (Figure 1) includes six hypotheses: (a) post-treatment nausea will be associated with the development of anticipatory nausea symptoms; (b) a patient's anxiety will be related to the development of anticipatory nausea symptoms; (c) a patient's anxiety will trigger the conditioning

process of development of anticipatory nausea symptoms via the development of post-treatment nausea symptoms; (d) a supportive family environment will be inversely associated with a patient's anxiety, which in turn, reduces the development of a patient's anticipatory nausea symptoms; (e) a supportive family environment will be inversely related to a patient's anxiety, which in turn, reduces the development of a patient's post-treatment nausea symptoms, which further reduces the development of a patient's anticipatory nausea symptoms; (f) finally, a supportive family environment may be directly associated with less development of patient anticipatory nausea symptoms, above and beyond the impact of his/her anxiety and development of post-treatment nausea symptoms. The last hypothesis is explorative due to lack of supportive findings in the existing literature. Symptoms of each post-treatment and anticipatory nausea will be examined by its severity and duration.

The conceptual model provided in Figure 1 will be tested using a latent growth structural model (McArdle & Bell, 2000), which allows us to distinguish the effects of individual differences in the patient's anxiety and symptoms of chemotherapy-related nausea at initial infusion of chemotherapy and levels of change over infusions. For example, the hypothesis (f) can be examined if supportive family environment is associated with the mean level of a patient's symptoms of anticipatory nausea across infusions or with the change (slope) of a patient's symptoms of anticipatory nausea over infusions. The latent growth structural modeling procedure will help clarify predictors of the development of anticipatory nausea.

#### Method

### Participants

The sample reported in Hickok and colleagues (1999) was used in the current study. Four male breast cancer patients in the above study were excluded, thus, only the 688 female patients with breast cancer were included in the study. Five hundred forty subjects completed the first five treatments, and 148 did not (22%). Those who did not complete the five treatments reported greater severity and duration of post-treatment nausea from infusion one to four, and greater severity and duration of anticipatory nausea at infusion four ( $t_s > 2.10$ ,  $p_s < .05$ ).

The average age of the 540 patients was 51 years (range 24 to 83), and most patients were married (75%), Caucasian (94%), and had at least a high school education (93%).

### Measures

Family Support. The Family Environment Scale (FES) assesses the environment in which a family creates and imposes expectations and demands for behavior upon its members (Moos & Moos, 1986), and was used to assess the degree to which a patient perceives support from the family. Five subscales that assess family relationships and the family system (45 items), which have been found in existing studies to be associated with a patient's adjustment, were selected as measures of supportiveness of the family environment (Williams, 1989). Three of these subscales (cohesion, expressiveness, and conflict) describe characteristics of family relationships. According to Moos and Moos (1986), cohesion is the degree of commitment, help, and support that family members provide for one another. Expressiveness is the extent to which family members are encouraged to act openly and to express their feelings directly. Conflict is the amount of

openly expressed anger, aggression, and disagreement among family members. The other two subscales (organization and control) are part of a construct domain generally seen as system maintenance. Organization is outlined as the degree of importance of clear organization and structure in planning family activities and responsibilities. Control is the extent to which set rules and procedures are used to regulate family life. The subscales' test-retest reliability for an eight-week interval range from .68 to .86 (Moos & Moos, 1986). The psychometric properties and validity of the FES have been established (Sanford, Bingham, & Zucker, 1999).

Anxiety. The extent to which the patients experienced nervousness, tension, and other correlates of anxiety was measured using the State and Trait Anxiety Inventory (STAI: Spielberger, Gorsuch, & Lushene, 1974), which is a self-report inventory with 20 items each for trait and state anxiety. Items are rated on a 5-point scale of distress (0 - 4), ranging from "not at all" to "extremely". Only the state anxiety score was included in the analyses. The STAI has been widely used, and its reliability and validity have been well documented (Spielberger, Sydeman, Owen, & Marsh, 1999).

Severity and Duration of Post-Treatment and Anticipatory Nausea. The Morrow Assessment of Nausea and Emesis (MANE: Morrow, 1992) was used to assess nausea. The MANE is a patient self-report measure of severity (measured on a 6-point scale from 0 = "not at all" to 6 = "intolerable") and duration (in hours) of both post-treatment and anticipatory nausea. The scale has been used in over two dozen recent research studies and its psychometric validity and reliability have been established (Carnrike et al., 1988; Morrow, 1992).

Emetic Potential Score of Chemotherapy Drugs. A clinical rating of the emetic potential of the patient's chemotherapy drug was calculated. Devised at the University of Rochester Medical Center by the Cancer Center pharmacist and nurse-clinicians, an emetic score from 0 (no emetic potential) to 4 (maximum emetic potential) was assigned to 53 drugs commonly used for chemotherapy. A total emetic score of chemotherapy regimen for each patient was calculated to serve as a covariate in the present study.

#### Procedure

Eligible patients were recruited at each participating site at the time of their first chemotherapy treatment. Patients who agreed to join the study signed a consent form, and demographic and clinical data were gathered from medical charts. At the second chemotherapy treatment (before drugs were administered to the patient), the patient completed the FES and the anxiety measure. The patient also completed the MANE regarding the first treatment. A questionnaire packet, including the anxiety measure and the MANE, was then given to the patient to complete after each chemotherapy treatment up to and including the fifth treatment. Patients were asked to return these questionnaires one week following each chemotherapy treatment using a stamped, self-addressed envelope. Compliance with this procedure was high; on the rare occasion that a participant failed to return the form(s), a reminder contact was made by phone.

#### Results

Means and standard deviations of study variables are reported in Table 1. Zero-order correlations among the family environment subscales are reported in Table 2 and zero-order correlations among the anxiety and nausea measures across treatment infusions are reported in Table 3. Then, zero-order correlations between the family

environment subscales, emetic rating score, anxiety, and nausea measures across treatment infusions are reported in Table 4.

### Model Specification

Psychometric properties of measures included in the present study to measure the proposed four latent variables (see Figure 1) were examined using structural equation modeling (AMOS 4.0: Arbuckle & Wothke, 1999). As shown in Figures 2 and 3, the model parameters were specified as follows: the family support latent variable was measured by the five subscales of the FES; the anxiety latent variable was specified with its mean level and its change (slope) across four infusions; and anticipatory and post-treatment nausea latent variables were measured by either the severity or the duration of the respective symptom with its mean level and its change (slope) across four infusions. In addition, a covariate of emetic potential rating score of the chemotherapy regimen was included in the model to predict both levels and slopes of chemotherapy-related nausea.

The observed variables for each relevant latent variable were specified not to have zero loading on the relevant factor, while the loadings on the other factors were constrained to equal zero. For example, within family support factors, conflict was specified not to have zero loading on the family support latent variable, while the loadings on measures for other latent variables (i.e., anxiety, post-treatment nausea, and anticipatory nausea) were constrained to equal zero.

To decipher the characteristics of the development of nausea using latent growth structural modeling, two latent components each of anxiety, post-treatment nausea, or anticipatory nausea were specified (Browne & De Toit, 1991; Chan, 1998; McArdle & Bell, 2000), as shown in Figures 2 and 3. First, infusion-level growth trajectories were fit



for measures of the same constructs obtained on multiple infusions. This infusion-level latent reflects the individual's initiation into longitudinal growth trajectories (i.e., level). The factor loadings for this "level" latent variable were fixed as 1 as a means of indexing the infusions' true initial status on the value of the latent variable at the first infusion point. Second, infusion-slope growth trajectories were fit to reflect differences in infusions in longitudinal growth trajectories (i.e., slope). The factor loadings for this "slope" latent variable were set 0 and 1 for the first and the second measurements, and set free for the third and fourth measurement. By this process, the "slope" latent variable serves to index changes of each latent variable over infusions. "Level" and "slope" latent variables for each of anxiety, post-treatment nausea, or anticipatory nausea were allowed to covary. Error matrices of observed variables were freed to allow them to correlate diagonally, and all other off-diagonal elements in the measurement error matrices were fixed to zero.

As shown in Figures 2 and 3, anticipatory nausea at infusions two to five were hypothesized to be predicted by characteristics of the family, which were measured at the beginning of the study, as were anxiety and post-treatment nausea at infusions one to four. Lagged observed measures between anticipatory nausea and both anxiety and post-treatment nausea were used to control for a potential confounding effect of measuring symptoms of anticipatory nausea simultaneous with the level of anxiety and symptoms of post-treatment nausea.

The specified latent growth structural modeling was repeated to predict either the severity of anticipatory nausea (Figure 2) or the duration of anticipatory nausea (Figure 3). The following four model fit indices were used in the present study: the goodness of

fit index (GFI), the confirmatory fit index (CFI), the normed fit index (NFI), and the root mean squared error of approximation (RMSEA). For the RMSEA measure, values of  $< .08$  (Browne & Cudeck, 1993) and for the GFI, CFI, and NFI, values of  $> .9$ , reflect adequate fits of a specified model to the data (Marsh, Balla, & McDonald, 1988).

#### Test of Measurement Fit

A confirmatory factor analysis using a structural equation model established that all five subscales loaded significantly on one Family Support construct and the model fit was acceptable, after allowing an error term between organization and control to be correlated to improve the model fit,  $GFI = .96$ ,  $CFI = .90$ ,  $NFI = .90$ , and  $RMSEA = .16$ . Standardized regression weights for the latent factor of Family Support for each of the five subscales were as follows: .79 (cohesion), .42 (expression), -.69 (conflict), .56 (organization), and -.26 (control),  $ps < .001$ . Thus, a “supportive” family environment can be defined as a cohesive family relationship that encourages emotional expression with little conflict and an organized family system with little control.

The standardized regression weights for the anxiety latent variable across infusions one to four ranged from .75 to .83; for post-treatment nausea across infusions one to four the range was from .77 to .82 for severity and from .75 to .82 for duration; anticipatory nausea across infusions two to five ranged from .42 to .50 for severity and .54 to .70 for duration,  $ps < .001$ .

#### Test of the Model Structure: Predicting the Severity of Anticipatory Nausea

The fit of the proposed latent growth structural model was satisfactory:  $\chi^2_{(110)} = 232.70$ ,  $GFI = .96$ ,  $CFI = .96$ ,  $NFI = .93$ , and  $RMSEA = .045$ . As shown in the left column of Table 5 and depicted in Figure 2, the hypothesis (a) of the effect of post-

treatment nausea on anticipatory nausea was supported by the impact of the mean level of post-treatment nausea severity on both the mean level and changes (slope) of severity of anticipatory nausea. Hypothesis (b) regarding the direct effect of a patient's anxiety on the development of anticipatory nausea was not supported. Thus, hypothesis (d), the indirect effect of family support on anticipatory nausea via anxiety, was also not supported.

The hypothesis (c) of the indirect effect of a patient's anxiety on the development of anticipatory nausea via post-treatment nausea was supported for levels of latent variables. In addition, the hypothesis (e) of an indirect effect of family support on anticipatory nausea via anxiety and post-treatment nausea was supported. The following three associations were significant: between family support and a patient's level of anxiety, between the level of anxiety and the level of severity of post-treatment nausea, and between the level of severity of post-treatment nausea and both the level and slope of severity of anticipatory nausea. A supportive family is associated with a lower level of patient anxiety, which in turn, is associated with a less severe level of post-treatment nausea, which is then related to a less severe level as well as a lower increase in the severity of patient anticipatory nausea.

The last hypothesis (f) that proposes the direct relationship between family support and anticipatory nausea confirms the level of the severity of anticipatory nausea but not the slope of severity of anticipatory nausea. Shown here is that a supportive family environment is associated with a less severe level of a patient's anticipatory nausea across infusions; it is not associated with changes in severity of a patient's anticipatory nausea.

Finally, the emetic potential rating score of chemotherapy regimen for each patient was not significantly related to the levels or changes of both types of nausea severity.

#### Test of the Model Structure: Predicting the Duration of Anticipatory Nausea

The fit of the proposed latent growth structural model was satisfactory:  $\chi^2_{(110)} = 231.00$ , GFI = .96, CFI = .96, NFI = .93, and RMSEA = .045. As shown in the right column of Table 5 and depicted in Figure 3, hypothesis (a) regarding the direct relationship between post-treatment nausea and anticipatory nausea was significantly supported by levels of latent variables. Hypothesis (b), concerning the direct effect of a patient's anxiety on the development of anticipatory nausea, was not supported. Thus, hypothesis (d), the indirect effect of family support on anticipatory nausea via anxiety, was also not supported.

The hypothesis (c) that proposes indirect effect of a patient's anxiety on the development of anticipatory nausea via post-treatment nausea was supported for levels of latent variables. In addition, the hypothesis (e) regarding the indirect effect of family support on anticipatory nausea via anxiety and post-treatment nausea was supported for levels of latent variables. The following three associations were significant: between family support and a patient's level of anxiety, between the level of anxiety and the level of duration of post-treatment nausea, and between the level of duration of post-treatment nausea and the level of duration of anticipatory nausea. A supportive family is associated with a lower level of patient anxiety, which in turn, is associated with a shorter duration of post-treatment nausea, which is then related to a shorter duration of patient anticipatory nausea.

The hypothesis (f) of the direct relationship between family support and anticipatory nausea was again supported for the level of duration of anticipatory nausea but not for the slope of duration of anticipatory nausea. A supportive family environment is associated with a shorter duration of patient anticipatory nausea across infusions but not with changes in the duration of patient anticipatory nausea over infusions.

In summary, the results indicate that a supportive family environment indirectly predicted the symptoms of anticipatory nausea via lower levels of patient anxiety and symptoms of post-treatment nausea, or directly predicted lower levels of both severity and duration of anticipatory nausea.

### Discussion

This study examined psychosocial predictors of the development of a patient's anticipatory nausea during chemotherapy treatment. Two major findings suggest that family environment influences the development of patient anticipatory nausea. First, supportive family environment was related to lower levels of patient anticipatory nausea symptoms, directly, or indirectly through lowering the patient's anxiety and reducing symptoms of post-treatment nausea. Second, these findings were stronger and more consistent at mean levels of symptoms across infusions rather than at changes of symptoms over infusions. These effects of family support were independent of the effect of emetic drugs on symptoms of chemotherapy-related nausea.

Specifically, the results in the present study revealed that the association between family support and anticipatory nausea symptoms was mediated by the degree to which a patient experienced anxiety and actual symptoms of nausea after receiving chemotherapy at each infusion. Each association among these factors has been found separately in

previous empirical studies (e.g., Andrykowski & Jacobsen, 1993; Koopman et al., 1998; Morrow, Roscoe, Kirshner et al., 1998), but none of these studies has examined the associations among the factors in a simultaneous and longitudinal model. The results in the present study also showed that family environment had a direct impact on a patient's symptoms of anticipatory nausea due to chemotherapy treatment for cancer, above and beyond the impact of the patient's anxiety and symptoms of post-treatment nausea. This effect of family environment was significant for both severity and duration of anticipatory nausea.

This finding supports the family systems theory (Steinglass, 1987), which posits that balance between family's growth tendency to become more complex in its structure and its regulatory tendency to maintain stability and order over time is necessary for healthy family functions. An unbalanced or disruptive family environment has been shown to increase psychosomatic complaints from family members in non-patient population (Holahan & Moos, 1986). This finding is also consistent with existing empirical studies on a patient's physical adjustment to cancer (e.g., Friedman et al., 1994; Mesters et al., 1997; Williams, 1989). In addition, the finding in the present study highlights the unique contribution of family support to a patient's adjustment for cancer treatment, because the impact of family support on the degree to which a patient develops anticipatory nausea was clear even in the context of hypothesized mediators in a model using structural equation modeling. Thus, family support can be a single target for developing intervention programs to help reduce patient nausea symptoms due to chemotherapy.

The present study helps to clarify the dynamics among predictors of anticipatory nausea development using a latent growth structural model, examining both the levels and changes of the study variables across infusions. The results in the present study illustrated that direct and indirect effects of family support on the development of symptoms of anticipatory nausea (through anxiety and symptoms of post-treatment nausea), were significant in predicting mean levels of symptoms across infusions but not in predicting changes of symptoms over infusions. It seems that the beneficial effects of supportive family environment on the symptoms of chemotherapy-related nausea are stable across infusions. A study of patients with Hodgkin's disease found that those who reported developing anticipatory symptoms during their cancer treatment were more likely to continue to experience difficulties during the post-treatment period (Cameron et al., 2001). Results in the present study further suggest that it may be crucial to identify patients whose familial environment is disruptive, at the beginning of a course of chemotherapy treatment before the patients develop conditioned responses. The object of this process of identification is to prevent any detrimental impact on the patient's adjustment to treatment during the course of chemotherapy infusions, or even long after treatments end. The findings imply that at an early stage of treatment, helping patients and their families communicate in more satisfactory and supportive ways, and maintaining an organized family system, would be beneficial in reducing the patient's anxiety and chemotherapy-related nausea during cancer treatment.

The finding that a supportive family environment contributed significantly to a patient's well-being, even when potential pharmacological impact on nausea was controlled, suggests that non-pharmacological or psychological factors play a significant

role in inhibiting development of chemotherapy-induced nausea. This finding is consistent with empirical studies (e.g., Jacobsen et al., 1988) and a meta-analysis on the effects of psychosocial interventions on adult cancer patients' adjustment (Meyer & Mark, 1995).

### Limitations

Limitations of this study should also be addressed. First, only the patients' perceptions of their family environment were assessed. Family dynamics are reciprocal between patients and their family members (Nicassio, Radojevic, Scholenfeld-Smith, & Dwyer, 1995); thus, both the patient's and the family members' perceptions about adjustment need to be included in future studies. Second, the present study assessed the family as a group instead of assessing specific individuals in the family. Certain individuals in a family may exert a greater influence than others on a patient's adjustment to cancer. The unique roles of individual family members in specific domains of patient coping need to be clarified to better understand how the family's dynamic processes affect patient adjustment. Third, all measures used in the present study were patient's self-report, thus there may be a potential issue of response bias. Fourth, because each questionnaire packet was given to the subject to complete at home and to be returned in a week, the assessments for anxiety and nausea were retrospective and the actual time questionnaires were answered was not available. Although this weakness in study design was compensated for by using information of anxiety from a previous infusion to predict the severity and duration of anticipatory nausea at a target infusion, obtaining a patient's anxiety level before getting an infusion would be ideal to control for any potential



artifact. Finally, the findings in the present study need cautious interpretation when applied to cancer populations other than female breast cancer patients.

#### Future Directions and Conclusion

In the present study, the level of a patient's anxiety mediated the impact of family support on the levels of symptoms of post-treatment nausea, whereas it did not mediate family support on the levels of symptoms of anticipatory nausea (although it did so via post-treatment nausea). These findings about the different roles of family support and a patient's anxiety on two types of highly related chemotherapy-induced nausea need to be replicated with heterogeneous populations. In addition, because family support had direct significant impact on the development of anticipatory nausea above and beyond the contribution of anxiety and post-treatment nausea, other mechanisms on the role of family support on a patient's anticipatory nausea should be explored in future studies. Patients' expectations, as an example, may play a significant role in the development of chemotherapy-related nausea or vomiting (Montgomery et al., 1998; Roscoe, Hickok, & Morrow, 2000). A patient's optimism (Carver et al., 1993) and certain coping styles, such as emotional expression (Stanton et al., 2000), may be associated with his/her perception of the family environment as well as the degree to which he/she feels anxious about chemotherapy treatments. Hence, the patient's attitude and behavior may be related to the development of chemotherapy-induced nausea.

The changes in anxiety and symptoms of chemotherapy-related nausea in the present study were not significant predictors of either the level or the change of symptoms of anticipatory nausea. Supplementary analyses excluding slope latent variables from the full model proposed in the study showed that the models without slope

(change) latent variables were significantly worse than the model including slope latent variables, both for severity and duration ( $\chi^2_{\text{diff}} = 122.70, 109.9$  with  $df = 20$ ,  $ps < .01$ , respectively.) Hence, there were significant contributions of changes in the latent variables explaining the development of symptoms of anticipatory nausea over infusions. However, the mean level of family support and changes in both anxiety and symptoms of post-treatment nausea were not significantly associated with the development of symptoms of anticipatory nausea. Future studies are needed to find factors that are sensitive to changes in the development of symptoms of anticipatory nausea over infusions.

Furthermore, although family environment is generally considered to comprise stable characteristics that family members display over time, a major stressor, such as the occurrence of cancer in a family member, can alter familial relationships and ways of interacting. Thus, the role of family environment and changes that occur in it at different treatment stages (i.e., immediately after the diagnosis, during treatment, or after treatments end) also need to be examined in future studies.

The findings of the present study support the general propositions set forth in the family systems theory and provide empirical evidence that family environment influences a patient's adjustment to medical situations, specifically, nausea related to chemotherapy. Follow-up studies will be needed to examine more refined mechanisms to decipher the effect of family support on a patient's symptoms of anticipatory nausea. Intervention programs designed to help patients and families express feelings openly, avoid conflict, and maintain a balanced family structure may prove beneficial for their adjustment to cancer.

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Table 1. Means and SD's of Study Variables

	Tx1	Tx2	Tx3	Tx4	RX5
<u>Family Environment Scale</u>					
Cohesion	57.75 (12.83)				
Expression	54.74 (12.16)				
Conflict	42.29 (10.39)				
Organization	54.84 (11.88)				
Control	46.87 (10.75)				
<u>Emetic Score</u>	5.35 ( .94)				
<u>Anxiety</u>	38.24 (11.97)	38.14 (11.91)	39.81 (12.54)	39.91 (12.71)	39.49 (12.49)
<u>Severity of Nausea</u>					
Post-treatment	1.78 ( 1.59)	1.66 ( 1.58)	1.54 ( 1.57)	1.51 ( 1.55)	1.56 ( 1.57)
Anticipatory		.33 ( .87)	.35 ( .87)	.34 ( .87)	.49 ( 1.03)
<u>Duration of Nausea (hours)</u>					
Post-treatment	22.53 (32.92)	19.80 (30.57)	23.35 (33.48)	23.58 (33.64)	23.84 (34.07)
Anticipatory		4.31 (17.07)	3.84 (14.95)	3.18 (13.86)	4.30 (15.21)

Note. Tx = Treatment Infusion; Numbers in parentheses are SD's

Table 2. Zero-Order Correlations among Family Environment Subscales

	1	2	3	4	5
1. Cohesion	-				
2. Expression	.38***	-			
3. Conflict	-.54***	-.14***	-		
4. Organization	.47***	.11*	-.39***	-	
5. Control	-.13**	-.29***	.23***	.14***	-

\*  $p < .05$

\*\*  $p < .01$

\*\*\*  $p < .001$

Table 3. Zero-Order Correlations among Anxiety and Nausea Measures Across Treatment Infusions

	1	2	3	4	5	6	7	8	9	10	11	12
1. Anx_1	-	.64	.56	.55	.16	.08	.08	.07	.06	.04	.01	.07
2. Anx_2	.64	-	.70	.70	.16	.18	.10	.12	.08	.06	.05	.08
3. Anx_3	.56	.70	-	.71	.11	.11	.10	.13	.07	.10	.08	.06
4. Anx_4	.55	.70	.71	-	.12	.17	.14	.16	.10	.08	.06	.13
5. PN_1	.19	.18	.20	.21	-	.56	.44	.39	.26	.15	.19	.20
6. PN_2	.16	.26	.23	.25	.58	-	.53	.50	.23	.22	.21	.22
7. PN_3	.16	.21	.25	.22	.51	.64	-	.60	.15	.21	.17	.18
8. PN_4	.11	.18	.20	.24	.46	.56	.63	-	.12	.19	.23	.22
9. AN_2	.14	.15	.12	.20	.25	.30	.19	.15	-	.37	.30	.26
10. AN_3	.09	.17	.19	.20	.19	.26	.31	.26	.34	-	.54	.40
11. AN_4	.08	.17	.17	.16	.23	.27	.32	.35	.29	.50	-	.51
12. AN_5	.18	.20	.22	.27	.26	.31	.33	.37	.32	.51	.52	-

Note. Correlation coefficients below the diagonal are for severity of nausea measures and above the diagonal are for duration of nausea measures; correlation coefficients greater than .09 are significant at  $p < .05$ ;  
 \_1 was measured at the first infusion; \_2 was measured at the second infusion;  
 \_3 was measured at the third infusion; \_4 was measured at the fourth infusion;  
 \_5 was measured at the fifth infusion; Anx = Anxiety;  
 PN = Post-treatment Nausea; AN = Anticipatory Nausea

Table 4. Zero-Order Correlations between Family Environment Subscales, Emetic Score, and Anxiety, Nausea Measures Across Treatment Infusions

	Cohesion	Expression	Conflict	Organization	Control	Emetic Score
<u>Anxiety</u>						
Anx_1	-.20***	-.14***	.17***	-.08	.11	-.02
Anx_2	-.26***	-.19***	.24***	-.15***	.14***	-.02
Anx_3	-.26***	-.15***	.22***	-.12**	.06	.02
Anx_4	-.24***	-.16***	.21***	-.12**	.06	-.02
<u>Severity of Nausea</u>						
PNS_1	-.04	.02	.01	-.02	.06	.07
PNS_2	-.10*	-.01	.05	-.01	.16***	.05
PNS_3	-.13**	-.02	.10*	-.04	.16***	.08
PNS_4	-.07	.05	.09*	-.06	.07	.03
ANS_2	-.11*	-.06	.04	-.06	.02	.04
ANS_3	-.18***	-.03	.15***	-.09*	.03	.09*
ANS_4	-.15***	-.03	.17***	-.11*	.02	.01
ANS_5	-.08	.06	.08	-.08	-.01	.07
<u>Duration of Nausea</u>						
PND_1	.05	.08	-.01	.02	.12**	.07
PND_2	.02	.02	.02	.02	.14***	.02
PND_3	-.04	.01	.09*	-.01	.13**	.05
PND_4	-.05	.05	.10*	-.07	.07	.03
AND_2	-.06	.01	.06	-.04	.02	.02
AND_3	-.06	-.02	.14***	-.02	.03	.05
AND_4	-.12**	.01	.05	.00	-.01	.06
AND_5	-.06	.03	.10*	-.03	.04	.10*

\*  $p < .05$       \*\*  $p < .01$       \*\*\*  $p < .001$

Note. \_1 was measured at the first infusion; \_2 was measured at the second infusion;  
 \_3 was measured at the third infusion; \_4 was measured at the fourth infusion;  
 \_5 was measured at the fifth infusion; Anx = State Anxiety; PNS = Post-treatment Nausea Severity;  
 ANS = Anticipatory Nausea Severity; PND = Post-treatment Nausea Duration;  
 AND = Anticipatory Nausea Severity

Table 5. Standardized Estimates of Paths in Predicting Anticipatory Nausea

	Severity	Duration
Family Support → Anxiety_Level	-.37***	-.36***
Family Support → Anxiety_Slope	.02	.02
Family Support → PN_Level	.01	.11
Family Support → PN_Slope	.11	.24
Family Support → AN_Level	-.27**	-.15
Family Support → AN_Slope	.16	-.05
Anxiety_Level → PN_Level	.33***	.29***
Anxiety_Level → PN_Slope	.19	.17
Anxiety_Level → AN_Level	-.05	-.06
Anxiety_Level → AN_Slope	.28	-.09
Anxiety_Slope → PN_Level	-.09	.09
Anxiety_Slope → PN_Slope	.30	.16
Anxiety_Slope → AN_Level	-.31	-.12
Anxiety_Slope → AN_Slope	.20	-.15
PN_Level → AN_Level	.45***	.43***
PN_Level → AN_Slope	.34*	.01
PN_Slope → AN_Level	.50	-.01
PN_Slope → AN_Slope	-1.15	.08
Emetic Score → PN_Level	.09	.07
Emetic Score → PN_Slope	.05	.03
Emetic Score → AN_Level	.00	.03
Emetic Score → AN_Slope	.08	-.07

\*  $p < .05$ \*\*  $p < .01$ \*\*\*  $p < .001$ 

Note. PN = Post-treatment Nausea; AN = Anticipatory Nausea

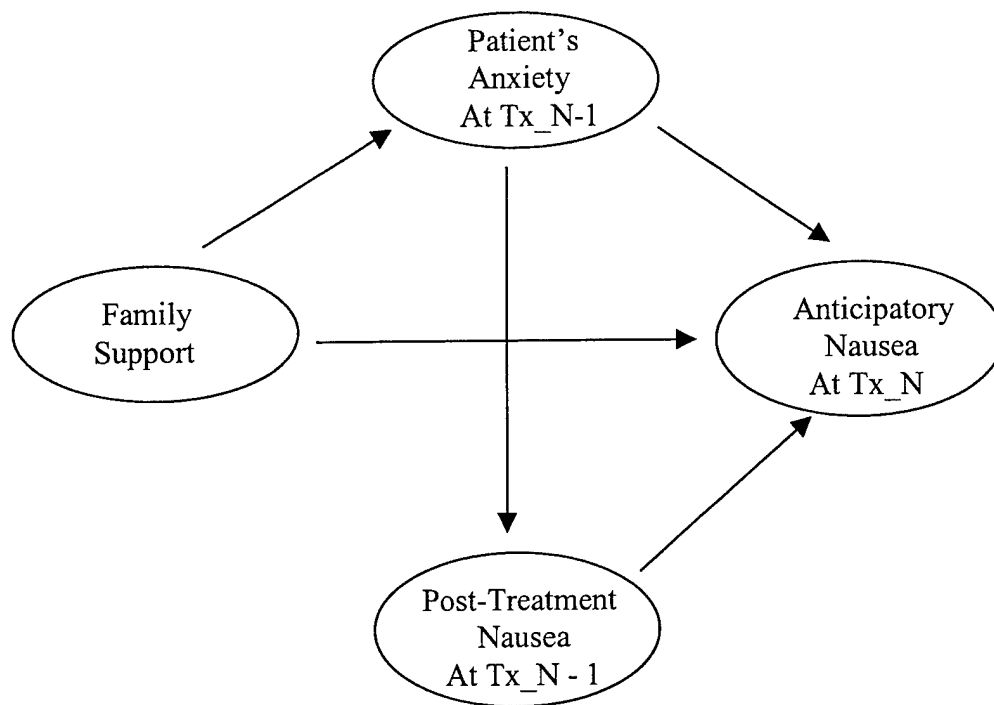
### Figure Caption

Figure 1. Model of Predictors of Anticipatory Nausea

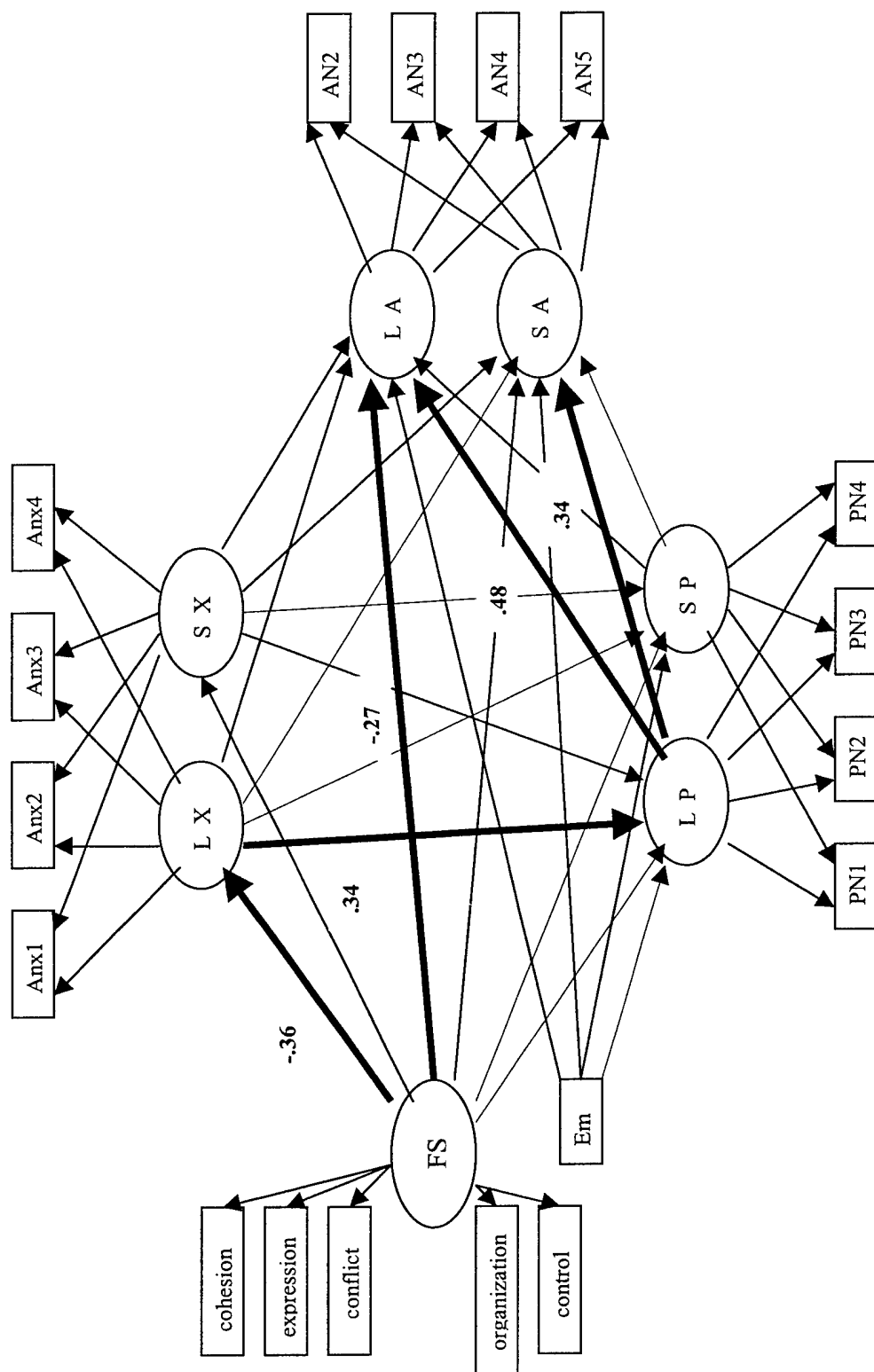
Figure 2. Latent Growth Structural Model of Predictors of the Severity of Anticipatory Nausea

Figure 3. Latent Growth Structural Model of Predictors of the Duration of Anticipatory Nausea

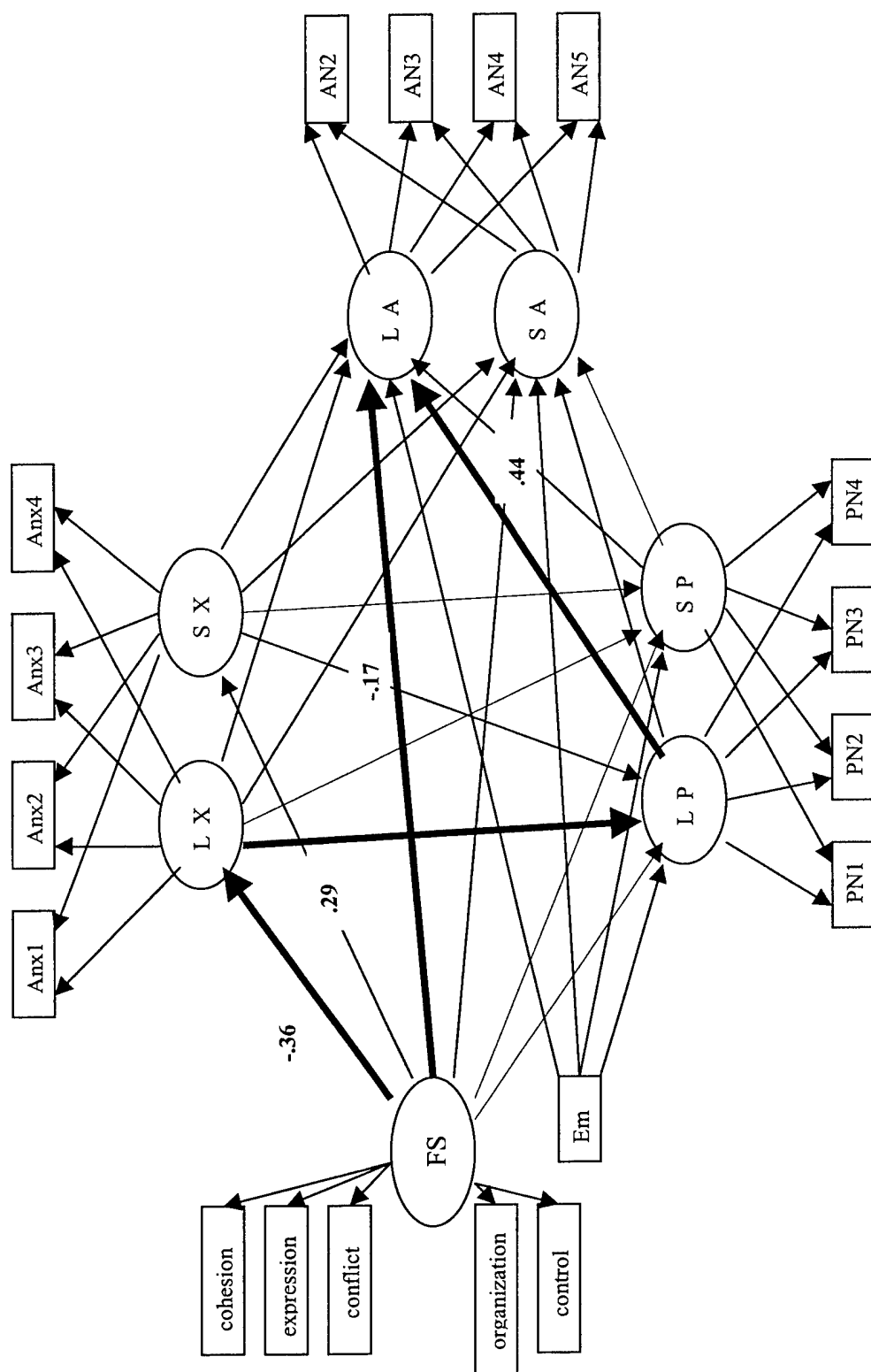




Note: Tx\_N = number of a target infusion; Tx\_N - 1 = previous infusion of a target infusion



Note. FS = Family Support; L\_X = Level of Anxiety; S\_X = Slope of Anxiety; L\_P = Level of Post-treatment Nausea; S\_P = Slope of Post-treatment Nausea; L\_A = Level of Anticipatory Nausea; S\_A = Slope of Anticipatory Nausea; Em = Emetic potential rating score of chemotherapy regimen; Anx = Anxiety; PN = Post-treatment Nausea; AN = Anticipatory Nausea; numbers are infusion number; solid highlighted paths are significant at  $p < .05$ ; Numbers are standardized estimates of the significant path; Measurement errors and covariances were included in the analysis but are omitted from the figure for graphical simplicity.



Note. FS = Family Support; L\_X = Level of Anxiety; S\_X = Slope of Anxiety; L\_P = Level of Post-treatment Nausea; S\_P = Slope of Post-treatment Nausea; L\_A = Level of Anticipatory Nausea; S\_A = Slope of Anticipatory Nausea; Em = Emetic potential rating score of chemotherapy regimen; Anx = Anxiety; PN = Post-treatment Nausea; AN = Anticipatory Nausea; numbers are infusion number; solid highlighted paths are significant at  $p < .05$ ; Numbers are standardized estimates for the significant path; Measurement errors and covariances were included in the analysis but are omitted from the figure for graphical simplicity.

Autonomy and collectivism:  
Complementary, not conflicting

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Running Head: Autonomy and collectivism

Abstract

Self-determination theory (SDT; Deci & Ryan, 2000) posits a universal need for autonomy. This claim has been questioned by cross-cultural theorists, who point to the strong collectivism found within many non-Western cultures. Believing that autonomy is often misinterpreted as reactive independence-seeking, we set out to show that autonomous motivation, defined and measured in SDT terms, is quite consistent with collectivist values. In both Study 1 sub-samples, felt autonomy regarding self-generated personal goals correlated positively with horizontal collectivist values, and negatively with vertical individualist values. Also, in both sub-samples the association of goal-autonomy with subjective well-being (SWB) was invariant across people with different cultural values. Study 2 showed that positive levels of goal-autonomy occurred in South Korean, Chinese, Taiwanese, and Turkish as well as U.S. samples, and that goal-autonomy was predictive of at least some measures of SWB within every culture. It appears that autonomous self-regulation or self-ownership may indeed be universally beneficial.

Self-determination theory (SDT) attempts to explain the nature of optimal functioning, and the conditions that promote it (Ryan & Deci, 2000). The theory postulates that there are basic needs whose satisfaction is essential to psychological integrity and well being—specifically, needs for autonomy, competence and relatedness. Of these three needs the most controversial has been the need for autonomy. According to SDT, autonomy concerns the experience of being volitional, such that one's behavior is done with a sense of willingness and self-endorsement. Persons are autonomous either when intrinsically motivated, or when acting in accordance with values and practices that have been internalized and integrated to the self. Over the past several years much new research has appeared to support SDT's organismic assumptions regarding the importance of autonomous self-regulation for both motivation and for subjective well-being (SWB; Deci & Ryan, 2000, 2001; Sheldon, Joiner, & Williams, in press).

However, recent research in the cross-cultural literature poses a significant challenge to the SDT perspective. Cross-cultural researchers have demonstrated many important differences between people living in collectivist-type cultures and those living in more individualistic cultures. These include differences in the amount and nature of self-esteem, differences in the employment of self-enhancement biases, and differences in the amount of deference to group norms and expectations, to name but a few findings (see Markus, Kitayama, & Heiman, 1996; Triandis, 1997). Based on such research, some psychologists have called into question assumptions regarding the universality of the need for autonomy or self-determination. It has been specifically suggested that notions of autonomy or freedom have meaning only within Western individualist societies, and may not be applicable in more collectivist cultures (Markus & Kitayama, 1994; Markus et al., 1996), or in more traditionally vertical cultures, in which authority and tradition are pervasive themes (Miller, 1997). In these

viewpoints the concept of autonomy is usually fused or used interchangeably with the concept of independence, such that the experience of volition is not differentiated from the experience of "not relying on others."

### Defining Autonomy

This definition of autonomy as independence rather than as volition can be traced back at least to Murray (1938). Murray was one of the first proponents of the concept of psychological needs, and included autonomy as one of his proposed set. However he defined autonomy as the desire "to get free, shake off restraint, break out of confinement. To resist coercion and restriction. To avoid or quit activities prescribed by domineering authorities. To be independent and free to act according to impulse. To be unattached, unconditioned, irresponsible. To defy conventions" (p. 156). Given the reactive and anti-social nature of this definition, it is easy to see why some cross-cultural theorists have questioned the claim that a need for autonomy is a dominant feature of human nature.

In contrast, SDT defines autonomy as a state in which people feel a sense of full assent regarding their behavior, typically occurring when the behavior expresses well-assimilated or internalized values, meanings, and interests. According to this definition, autonomy does not refer to independence from the influence of others, but rather, to mature self-possession and self-concordance with one's actions (Sheldon & Elliot, 1999). In other words, one can feel quite autonomous even as one defers to others, provided that one fully identifies with what one is doing (Ryan & Lynch, 1989). Conversely, one can feel quite non-autonomous even as one diverges radically from others, as is often the case with psychological reactance. This distinction between autonomy and independence is based in both phenomenological and analytic philosophical studies (Ryan, 1993) as well as the everyday observation that people often

willingly and freely follow advice, concur with directives, and obey laws without any loss of experienced autonomy (see Dworkin, 1988).

In this vein, Koestner and his colleagues have made an important distinction between "reactive" and "reflective" autonomy, demonstrating in several studies that the former Murrayian conception of autonomy and the latter organismic conception of autonomy diverge in theoretically significant ways. For example, those high in reactive autonomy were shown to rebel against the advice of credible experts, whereas those high in reflective autonomy tended to follow such advice (Koestner, Gingras, Abutaa, Losier, Didio, & Gagne, 1999). As another example, Koestner and Losier (1996) showed that those high in reflective autonomy had more intimate and self-disclosing interactions with peers than those high in reactive autonomy.

Based on these distinctions, Deci and Ryan (2000) have argued that there is in fact a need for autonomy that is held in common by all human beings. Indeed, much cross-cultural data has recently emerged to support Deci and Ryan's (2000) claims. For example, Hayamizu (1997) found, in a sample of Japanese high school students, that autonomous motivation was related to positive coping, whereas non-autonomous or "controlled" motivation was associated with maladaptive coping. Similarly Tanaka and Yamauchi (2000) recently reported more adaptive learning styles and positive experiences in Japanese students whose motivation was more autonomous. Deci, Ryan, Gagne, Leone, Usunov, and Komazheva (2001) found, in a sample of Bulgarian adults, that felt autonomy on the job predicted work engagement, job performance, and SWB. Sheldon, Elliot, Kim, and Kasser (2001) found, in a sample of South Korean college students, that felt autonomy was one of the most important components of "satisfying events," and that event-related autonomy uniquely predicted positive SWB within this sample just as it does within American samples. Finally, Chirkov and Ryan (2001) showed that controlling versus autonomy supportive parents had negative effects on mental health in both



Russian and U.S. high school age youths (see Deci & Ryan, 2000a, for a more comprehensive consideration of this emerging literature).

In this article we try to demonstrate a) the non-isomorphism between autonomous self-regulation and self-centered individualism, and b) the importance of autonomous self-regulation across persons with distinct cultural values and styles. Moreover, we examine these issues with respect to peoples' idiographic personal goals, a methodology that has been little employed in cross-cultural studies. Specifically, we examine whether people of different cultural styles vary in their sense of autonomy regarding important life goals, and, to what extent goal-autonomy predicts SWB for people of all types.

### The Nature of Personal Goals

The last decade has seen an explosion of research concerning idiographic personal goals, that is, peoples' self-generated life-initiatives (Austin & Vancouver, 1996; Sheldon & Elliot, 2000). Idiographic goal-methodologies provide an ecologically valid way of assessing "what people are trying to do" via their daily behavior (Emmons, 1989, Little, 1993). Although such methods allow individuals latitude to express their unique concerns, they also allow nomothetic comparisons to be made between individuals, based on their appraisals of their goals. In terms of McAdams' (1996) typology of levels of analysis in personality theory, personal goals represent the important "second tier," midway between dispositional traits and narrative self-identities. In addition, self-generated personal goals provide a unit of analysis midway between projective (implicit) motive methodologies, on the one hand, and self-attributed (explicit) motive methodologies (Emmons & McAdams, 1991; McClelland, Koestner, & Weinberger, 1989), on the other. Thus, the importance of understanding personal goals, if one wants to understand basic personality processes, is clear.

Notably, some might view personal goals as an inherently individualistic construct, given that goals by definition concern peoples' proactive personal initiatives (Markus et al., 1996).

However, along with other contemporary goal theorists, we assert that goals are actually among the most important means by which individuals adapt to social contexts and enhance their connectivity with others (Cantor & Sanderson, 1999; Salmelo-Aro & Nurmi, 1996). That is, rather than being inherently self-centered, many goals instead concern the external world, especially the world of social roles and interpersonal concerns (Ryff & Singer, 1998, Salmelo-Aro & Nurmi, in press; Sheldon & Elliot, 2000). The fact that many personal goals address social tasks is only logical, given that perhaps the primary adaptive environment for *homo sapiens*, throughout its history, has been the social environment (Caporael, 1997).

Consistent with this reasoning, SDT proposes a fundamental need for *relatedness*, as well as a need for autonomy (Deci & Ryan, 2000b). That is, in addition to a need to regulate their own behavior, SDT posits that people also have a need for connection or belongingness, which naturally motivates attempts to communicate with, support, and enjoy other people (Baumeister & Leary, 1995). According to SDT, both needs must be met for maximal thriving to occur. In broader terms, in keeping with its holistic and social-contextual roots (e.g., Angyal, 1965), SDT posits that humans have a propensity to seek greater integration not only internally, in terms of mastering their own emotions, impulses, and drives, but also externally, in terms of integrating themselves into the social environment. From this perspective, a self-integrated person very likely is a socially integrated person as well, as these two outcomes are expressions of similar organizational processes (Ryan, Kuhl & Deci, 1997). And indeed, much recent work has established that autonomy and relatedness tend to correlate positively, rather than negatively, as the more traditional (i.e. Murrayian) analysis might suggest (Bettencourt & Sheldon, 2001; Hodgins, Koestner, & Duncan, 1996; Sheldon & Bettencourt, in press).

#### Goal-Autonomy, Cultural Values, and SWB

Despite this reasoning, the fact remains that the empirical relations between autonomous goal-pursuit and collectivist-type value constructs have not yet been established.

Is the autonomous goal-striver an unbridled individualist, as suggested by some cross-cultural analyses, or is he or she instead likely to be an integrated person, both inter- and intra-personally, as suggested by SDT's organismically-based analysis? Thus, in this article we seek to explore the relationship of autonomous goal-pursuit to several important cultural constructs. Central to this analysis are the concepts of horizontal and vertical collectivism and individualism.

As discussed by Triandis (1997) and Triandis and Gelfand (1998), the horizontal/vertical dimension refers to equality or interchangeability among social units, on the one hand, versus hierarchical or subordinate relations between units, on the other. The individualism/collectivism dimension refers to different ways of defining the self (independent versus interdependent, respectively), and also to different attitudes regarding the importance of adhering to social groups, norms and traditions (resistant versus accepting, respectively). Crossing these two dimensions yields four cultural value-types. Horizontal collectivism is depicted as the tendency to "see oneself as similar to others and to emphasize common goals with others, interdependence, and sociability." Horizontal individualism is the tendency "to want to be unique and distinct from groups," and to be highly self-reliant. Vertical collectivism involves an emphasis on the integrity of the in-group, and competition between in-groups and out-groups. Vertical individualism involves wanting to become distinguished and acquire status, especially via direct competitions with others. These four value styles are understood as both individual difference and cultural difference variables, which encompass several important ways in which both people and cultures vary. One important question raised in the current research is the relation of cultural values to individual differences in the felt autonomy of personal goals.

As an indicator of personal thriving we assessed subjective well-being (SWB; Diener, 1994, Diener & Lucas, 1999) in both studies. Our approach views SWB as an outcome of psychological need-satisfaction, as well as a marker of adjustment to the social surrounding

(Ryan & Deci, 2000). Thus, to find that goal-autonomy is predictive of SWB for people of all value styles and cultures would corroborate our argument that the autonomy need is important for adaptation and thriving within any cultural context.

### Study 1

Study 1 consisted of two U.S. college student samples. In both samples we examined the associations between autonomous goal pursuit, as operationalized by the SDT model, and both horizontal collectivism and vertical individualism. These two value styles represent the two extremes of a continuum ranging from unmitigated collectivism (in which there is neither hierarchy nor conventional self-interest) to unmitigated individualism (in which individuals compete against each other to establish dominance). In keeping with our assumption that "true" autonomy does not conflict with social integration, but rather is complementary with it (Koestner & Losier, 1996), we expected a positive association between goal-autonomy and horizontal collectivism. Also, in keeping with our assumption that autonomy is very different from competitive or status-focused values, we expected a negative association between goal-autonomy and vertical individualism.

Participants within the second Study 1 sample were also administered measures of vertical collectivism and horizontal individualism. Again, vertical collectivism refers to an orientation towards in-group versus out-group competition, whereas horizontal individualism refers to the desire to be "unique and distinct from groups," and to be self-reliant (Triandis & Gelfand, 1998). We did not venture any predictions regarding the association of goal-autonomy with horizontal individualism, because although we would expect autonomy to accompany a horizontal or egalitarian orientation, we view autonomy as quite different from uniqueness or independence. We also did not predict an association of goal-autonomy with vertical collectivism, because self-determined goal-striving and strong inter-group concerns seemed logically orthogonal.

Participants in the second sample were administered measures of independent and interdependent self-construal (Singelis, 1994). Independent self-construal refers to the tendency to experience the self as an entity distinct from other selves, whereas interdependent self-construal refers to the tendency to construe the self as an entity inextricably linked with other selves. Prior research has established that interdependent self-construals are more prevalent in Asian and other collectivist cultures, whereas independent self-construals are more prevalent in western and other individualistic cultures (Triandis, 1997). In keeping with our assumption that goal-autonomy is associated with both personal and social integration, we hypothesized that goal-autonomy would be positively associated with both of these variables.

Finally, both samples were administered two widely-used measures of SWB, the Positive Affect Negative Affect Schedule (PANAS; Watson, Tellegen, & Clark, 1988) and the Satisfaction with Life scale (Diener, Emmons, Larsen, & Griffin, 1985). We expected to replicate prior results from U.S. samples showing that goal-autonomy is predictive of concurrent SWB (Sheldon & Elliot, 1999, Sheldon & Kasser, 1995). More importantly, we expected to find no interactions between goal-autonomy and value style in predicting SWB. That is, no matter what the content of their particular values, people should benefit when they are able to pursue autonomous personal goals.

## Methods

### Participants and procedure

Study 1 participants were all undergraduates at the University of Missouri, who participated in exchange for extra credit in a psychology class. Of the first sample of 279, 253 were Caucasian, 3 were Asian-American, 3 were Hispanic, 11 were African-American, and 9 were "other." Of the second sample of 149, 112 were Caucasian, 12 were Asian-American, 8 were Hispanic, 8 were African-American, and 9 were "other." Sample 1 participants completed all measures in a single group assessment, held at the beginning of the semester. Sample 2

participants completed the measures in two different group sessions, held at the beginning and near the middle of the semester.

### Measures

To measure horizontal collectivism, vertical individualism, horizontal individualism, and vertical collectivism, we used the measures developed by Triandis and Gelfand (1998). Each scale consisted of four items, administered with a 1 (strongly disagree) to 5 (strongly agree) scale. In sample 1, Cronbach's  $\alpha$  coefficients for horizontal collectivism and vertical individualism were .67 and .75. In sample two these coefficients were .67 and .64, and alpha coefficients for horizontal individualism and vertical collectivism were .63 and .62. The sample 2 questionnaire also included Singelis' (1994) 24-item measure of independent and interdependent self-construals, also administered with a 1 (strongly disagree) to 5 (strongly agree) scale. Separate independent and interdependent self-construal scores were computed by averaging relevant items (Cronbach's  $\alpha$  = .67 and .66, respectively).

In addition, all participants rated the 20 mood adjectives of the PANAS (Watson et al., 1988), indicating how much they have felt each emotion "in the past month or so." A 1 (very slightly or not all) to 5 (extremely) scale was employed, and both a positive affect and a negative affect score were derived by averaging the appropriate items (Cronbach's  $\alpha$  = .86 and .88, respectively). Participants also completed the five items of the Satisfaction with Life scale (Diener, Emmons, Larsen, & Griffin, 1985), also with reference to the past month or so, using a 1 (strongly disagree) to 5 (strongly agree) scale. These items were averaged to create a life-satisfaction score (Cronbach's  $\alpha$  = .81). As in other recent studies (Bettencourt & Sheldon, 2001; Elliot, Sheldon & Church, 1997; Sheldon & Elliot, 1999), we computed an aggregate measure of SWB by subtracting negative affect from the sum of positive affect and life-satisfaction (Diener, 1994).

Midway through the questionnaire, participants in both samples read "For the next part of the today's session, we will ask you to first identify a set of personal goals for yourself. These should be fairly general, concerning where you would ultimately like to go in life. However they should also be goals that you will at least begin working on this semester." Several examples were given, after which participants generated goals of their own. Participants in the first sample were asked to generate 8 goals, with no constraints upon the content. Participants in the second sample were asked to generate 6 goals, one in each of 6 content domains: money/financial, popularity, emotional intimacy, community contribution, personal growth, and physical attractiveness.<sup>1</sup>

Next, as a way of measuring the degree of autonomy or internal perceived locus of causality associated with goal-pursuit, participants rated four different reasons for pursuing each goal (Ryan & Connell, 1989). Specifically, as in much recent work (Sheldon & Elliot, 1999, 2000; Sheldon & Houser-Marko, 2001; Sheldon & Kasser, 1995, 1998), we asked participants to rate external, introjected, identified, and intrinsic reasons for goal-pursuit, using a 1 (not at all for this reason) to 5 (completely for this reason) scale. The former two reasons are conceptualized as non-internalized or non-autonomous forms of motivation, and the latter two reasons are conceptualized as internalized or autonomous forms of motivation. As in prior research we computed an aggregate goal-autonomy variable for each participant by summing the eight identified and the eight intrinsic ratings, then subtracting the eight external and the eight introjected ratings. Coefficient alpha for this 32-item composite (computed after recoding external and introjected scores) was .88.

## Results

Table 1 presents means and standard deviations for major study variables, for both samples. Table 2 presents the correlation between goal-autonomy and well-being, and the correlations between goal-autonomy and the culturally-relevant constructs, for both samples.

As can be seen in Table 2, goal-autonomy was significantly positively associated with horizontal collectivism and significantly negatively associated with vertical individualism, in both samples. These four associations support the major hypotheses of Study 1.

In addition, the sample 2 data revealed that goal-autonomy was also positively associated with horizontal individualism, and was unrelated to vertical collectivism (recall that we made no predictions regarding these two variables). As expected, goal-autonomy was positively correlated with independent self-construal. However goal-autonomy was not also associated with interdependent self-construal.

As a supplementary analysis we computed aggregate "horizontal," "vertical," "collectivist" and "individualist" variables by averaging the two horizontal measures, the two vertical measures, the two collectivist measures, and the two individualist measures, respectively. We then correlated these four indices with goal-autonomy. In this analysis, goal-autonomy was positively correlated with collectivism ( $r = .26$ ,  $p < .01$ ) and uncorrelated with individualism ( $r = -.02$ ,  $ns$ ). Goal-autonomy was also positively correlated with horizontal orientation ( $r = .36$ ,  $p < .01$ ) and uncorrelated with vertical orientation ( $r = -.06$ ,  $ns$ ). These analyses further suggest that autonomy is complementary with collectivism, not antithetical to it, and that autonomy involves an egalitarian orientation, not a hierarchical one.

Next, we turned to the SWB data. As predicted, goal-autonomy was associated with aggregate SWB, in both samples. These results replicate past findings (i.e. Sheldon & Elliot, 1999; Sheldon & Kasser, 1995, 1998). We then tested our primary SWB-related hypothesis, that goal-autonomy would not interact with cultural values to predict SWB. In preparation, goal-autonomy and all culturally-relevant measures were centered around the relevant sample mean. Then, eight product terms (two for sample 1, and six for sample 2) were computed by multiplying goal-autonomy by each of the eight measures (Cohen & Cohen, 1983). In each of eight regressions we predicted SWB by entering goal-autonomy and one of the culturally-



relevant measures together at the first step, then entering the relevant product term at the second step.

In sample 1, goal-autonomy manifested a significant positive effect upon SWB in both analyses. Vertical individualism had a significant negative effect upon SWB ( $\beta = -.17$ ,  $p < .01$ ), and horizontal collectivism had a marginally significant positive effect upon SWB ( $\beta = .11$ ,  $p < .10$ ). Most importantly, goal-autonomy did not interact with either of the two value measures to predict SWB (both  $ps > .40$ ), indicating that autonomous goal-pursuit is equally beneficial for those with both value styles. In sample 2, goal-autonomy significantly predicted SWB in all six analyses, and horizontal collectivism ( $\beta = .24$ ,  $p < .01$ ) and independent self-construal ( $\beta = .31$ ,  $p < .01$ ) were both significant predictors of SWB in their respective analyses. Most importantly, none of the six interaction product terms were significant in these analyses, again indicating that goal-autonomy may be beneficial for SWB regardless of a person's value or self-construal style.

### Brief Discussion

Study 1 results support our proposal that there is no inherent contradiction or conflict between autonomous goal-striving and group-oriented values, and moreover, suggest that these constructs may actually be quite complementary. Specifically, in both samples, participants scoring higher in the horizontal collectivism scale also tended to strive for more autonomous reasons. Furthermore, in both samples, vertical individualism was negatively associated with goal-autonomy, contradicting theoretical perspectives that equate autonomy and competitive individualism. Slicing the data somewhat differently, we also found that autonomy was positively associated with aggregate collectivism and aggregate horizontal orientation, and unrelated to aggregate individualism and aggregate vertical orientation.

As in past research, goal-autonomy predicted positive SWB. New to this research, the effects of goal-autonomy upon SWB were unmoderated by value style. That is, autonomous

functioning apparently benefited those with collectivist values and interdependent orientations just as much as it benefited those with individualist values or independent orientations.

These results are thus consistent with the SDT proposal that personality development is a dialectical process, in which the self must successfully negotiate with the social world in order to realize itself most fully. In other words, given that autonomy and relatedness need-satisfaction tend to co-occur (Bettencourt & Sheldon, 2001; Sheldon & Bettencourt, in press), there seems no reason to believe that autonomous goal-strivers cannot also be quite sensitive to social nuances and obligations. Indeed, the current data suggest that those who feel the greatest ownership of their goals also feel the greatest sense of equality and sociability with others (i.e. they tend to be more likely to espouse horizontal collectivist values).

### Study 2

A limitation of Study 1 is that cultural style was measured by personality inventory rather than by ethnic or cultural category (Triandis, 1997). Another limitation is that both Study 1 samples consisted of predominantly Caucasian U.S. college students. Obviously, our claim that goal-autonomy is consistent with collectivism and is universally beneficial for SWB would be considerably bolstered if we could show that the same patterns emerge across very different cultural contexts. We set out to do this in Study 2, specifically by comparing a U.S. sample to samples from several collectivist cultures: Turkey, South Korea, Mainland China, and Taiwan. By including these samples we obtained several different "flavors" of collectivism, including West Asian versus East Asian, traditional versus modern, vertical versus horizontal, and democratic versus communist.

We were uncertain what to predict regarding cultural mean differences in goal-autonomy. Based on the results for both Study 1 samples, one might predict greater autonomy in the collectivist cultures, especially horizontal collectivist cultures. However, past research suggests that citizens of collectivist cultures tend to have more interdependent self-construals

and less independent self-construals (Markus et al., 1996). Based on the results for the second sample of Study 1, one might thus predict less autonomy in the collectivist cultures.

Accordingly, we did not venture a hypothesis concerning mean differences in goal-autonomy in the U.S. compared to the other four cultures. However, based on the SDT assumption that autonomy is a universal human need (Deci & Ryan, 2000), we expected goal-autonomy to be associated with SWB in all five cultures. Paralleling Study 1, we also tested for possible interactions between culture and goal-autonomy in the prediction of SWB, expecting to find no moderator effects.

Finally, we also incorporated several culture-level variables into the mix: namely, Triandis's individualism rating for each culture, the emphasis on civil rights within the culture, and the average purchasing power or gross domestic product per person for each culture (see Diener, Diener, & Diener, 1995, for a table of these values).<sup>2</sup> These scores were distributed to each participant, according to the participant's cultural membership. We wished to examine whether goal-autonomy correlated with these variables, and also, whether goal-autonomy effects had any effects upon SWB independent of these variables.

## Methods

### Participants and Procedure

Six hundred and twenty-eight college undergraduates participated in the study, all of them students at large universities: 194 from South Korea (Hanyang University, in Seoul, South Korea)<sup>3</sup>, 153 from the U.S. (University of Missouri, in Columbia, Missouri, U.S.A.), 77 from Turkey (Middle Eastern Technical University, in Ankara, Turkey), 163 from Taiwan (National Sun Yat-sen University, in Kaohsiung, Taiwan), and 41 from Mainland China (awaiting information on this)<sup>4</sup>. Some participants were psychology students, but students came from many other areas as well, including English, accounting, management, engineering, and chemistry.

An English version of the questionnaire was created. Chinese, Taiwanese, and South Korea versions were created by a process in which a bi-lingual psychologist native to the country translated the questionnaire into the appropriate language, after which it was back-translated by a second individual proficient in both English and the language in question. The equivalence of the original and back-translated versions of the questionnaire were evaluated, and minor revisions were made to arrive at final versions of the questionnaire. The Turkish sample was administered the questionnaire in English, which is the official language of instruction at Middle Eastern Technical University. Of course, the Missouri sample also completed the questionnaire in English.

Participants attended small group sessions in which both their personal goals and their SWB were assessed. Participants completed the same SWB measures used in Study 1, namely, the PANAS and the Satisfaction with Life scale. The same 1 to 5 scale was employed as before, and as in Study 1, an aggregate SWB measure was also computed from these scores. Alpha coefficients ranged between .60 and .82 across the five samples for positive affect, between .63 and .83 for negative affect, and between .75 and .81 for life-satisfaction.

The personal goals assessment was worded somewhat differently than in Study 1. Specifically, all participants read a standard personal strivings assessment (Emmons, 1989), in which they were told "We are interested in the things that you typically or characteristically are trying to do in your everyday behavior. Think about the objectives that you are typically trying to accomplish or attain. We call these personal strivings." Participants were given examples of strivings, and were then asked to list eight personal strivings of their own.

All participants then rated the reasons they were pursuing each striving, in terms of the same four reasons employed in Study 1. A 1 (not at all for this reason) to 7 (completely for this reason) scale was employed. An aggregate goal-autonomy score was computed for each participant, in the same way as before. Cronbach's alpha coefficients for the goal-autonomy

variable were .79, .70, .80, .72, and .80, respectively, for the U.S., South Korean, Chinese, Taiwanese, and Turkish samples.

## Results

### Mean Differences Between Cultures

Table 3 presents descriptive statistics, separately for each sample. In addition, results from a series of matched group t-tests are presented, in which each Asian sample was compared to the U.S. sample. Consistent with past studies of national well-being (Diener et al., 1995), the U.S. sample evidenced higher levels of all three SWB measures, the only exceptions being that Turkish and Chinese participants did not report lower positive affect. The pattern of means was much less clear for goal-autonomy: Turkish participants actually reported slightly more autonomy than U.S. participants ( $p = .09$ ), whereas South Korean participants reported equal levels of autonomy compared to U.S. participants. However, Taiwanese and Chinese participants reported significantly less autonomy than U.S. participants. Notably, goal-autonomy was greater than zero in every culture. This indicates that in every cultural group, people felt more self-determined than controlled in their personal goals.

### Associations of Goal-Autonomy with SWB

Next we examined the associations between goal-autonomy and the SWB measures. Table 4 presents these correlations for the entire sample of 628, and also presents the associations of the three nation-level variables with the SWB measures. Notably, we do not provide significance tests for the latter three sets of associations, as these would be misestimated given that they concern the effects of a group-level factor upon individual data. The coefficients in Table 4 are provided primarily to illustrate effect sizes.<sup>5</sup>

Consistent with our hypotheses, goal-autonomy was positively correlated with positive affect, life-satisfaction, and aggregate SWB, and was negatively correlated with negative affect. Interestingly, the three nation-level measures (purchasing power, civil rights, and Triandis

individualism) also correlated with the SWB measures, with effects of approximately the same magnitude as the effects of the goal-autonomy variable. However, the three nation-level measures were only weakly correlated with goal-autonomy ( $r_s = .06, .07, \text{ and } .11$ , respectively), suggesting that feelings of autonomy are primarily determined by other factors than the level of GDP, civil rights, and individualism evidenced by the participant's nation.

What about variations across cultures? Table 5 presents the correlations of goal-autonomy with each SWB measure, separately in each culture. As can be seen, goal-autonomy correlated significantly as expected with at least one measure in every culture, and in no case did autonomy correlate significantly negatively with SWB. This pattern of findings provides reasonably good support for our hypotheses.

Next, we conducted regression analyses to examine two further questions. First, does the effect of goal-autonomy upon SWB persist even after the effects of individualism, civil rights, and purchasing power have been partialled out? If so, this would indicate that the individual-level autonomy effects are not reducible to these social-structural variables. Second, does goal-autonomy interact with culture to predict SWB? To find no interactions would further support the hypothesis that autonomy is a fundamental human need. To simplify the presentation we analyzed only the aggregate SWB variable. To further simplify we created a single indicator of "national individualism" by averaging the Triandis individualism rating, the purchasing power score, and the civil rights score, because these three quantities were highly correlated in our data (coefficient alpha for the aggregate = .98).

In the first analysis, the goal-autonomy to SWB effect was essentially unchanged when national individualism was entered into the equation ( $\beta = .30$ , compared to a zero-order correlation of  $r = .33$ ), even though the effect of national individualism was itself quite substantial ( $\beta = .34$ ). This indicates that the effects of goal-autonomy are not reducible to these three social-structural variables. Furthermore, there was no interaction between national

individualism and goal-autonomy to predict SWB ( $\beta = .07$ ,  $p > .19$ ), indicating that the effect of goal-autonomy does not depend upon the social-structural variables.

In the second analysis we regressed SWB upon goal-autonomy and also upon a dummy variable representing whether the participant was from the U.S. (0) or from Asia (1). Both standardized coefficients were significant (for goal-autonomy,  $\beta = .30$ ,  $p < .01$ , and for Asia,  $\beta = -.39$ ,  $p < .01$ ). More importantly for our hypotheses, the interaction of goal-autonomy and culture was not significant ( $\beta$  for the product term =  $-.05$ ,  $p > .50$ ). In other words, the association between goal-autonomy and SWB did not differ between the U.S. and the other four cultures taken together.

Finally, we conducted a third analysis, this time employing four dummy variables, one for each of the four Asian cultures, with the U.S. again coded 0. Again, goal-autonomy had a significant main effect ( $\beta = .26$ ,  $p < .01$ ), as did the set of four dummy variables (Multiple  $R = .48$ ,  $p < .01$ ). Next we entered four interaction product terms, one for each of the collectivist cultures. Although three of these terms were non-significant, the term representing Turkey was significant ( $\beta = -.17$ ,  $p < .05$ ). In other words, the association between goal-autonomy and SWB was significantly weaker in Turkish participants than in the rest of the sample. We will discuss possible reasons for this, below.

#### Brief Discussion

Consistent with past cross-cultural findings, Asian participants evidenced lower self-reported SWB than U.S. participants (Diener et al., 1995). However Asians did not necessarily experience less autonomy in their personal goals, suggesting that those living in collectivist cultures can feel strong ownership of their goals. Supporting our supposition that autonomy is beneficial for people of all cultures, goal-autonomy was positively correlated with at least one measure of SWB in every culture, and there were no significant effects counter to predictions. Furthermore, the association of autonomy with SWB was un-moderated by social-structural

variables such as purchasing power or civil rights, and was also independent of the contrast between Asian and U.S. culture. These findings provide good support for our general study hypotheses.

One less supportive finding concerned the Turkish sample, in which autonomy was not significantly correlated with aggregate SWB ( $r = .09$ ). Why the anomaly? First, we would point out that goal-autonomy was significantly associated with one of the three SWB measures (negative affect), and thus, our hypotheses received at least some support even in Turkey. It is also worth pointing out that the Turkish sample had the highest mean levels of autonomy, perhaps imposing a ceiling effect upon possible co-variations. From a substantive perspective, it is possible that the Turkish participants over-reported their felt autonomy, perhaps due to their proximity to and identification with contemporary European culture. The fact that the questionnaire was administered in English might also play a role, given that English is not the primary language for most of the students (although it is the official language of instruction for Middle Eastern Technical University). Obviously, it will be important to try to replicate these results using other Turkish samples, who are administered the questionnaire in the Turkish language.

### General Discussion

These two studies provide compelling evidence that autonomous goal-striving and collectivist values tend to be complementary, not conflicting. In keeping with SDT's organismic postulate that humans have innate tendencies to seek both social and personal integration (Deci & Ryan, 1985), and recent findings that autonomy and relatedness needs are often satisfied simultaneously (Hodgins et al., 1996; Sheldon & Bettencourt, in press), Study 1 found consistent positive associations between horizontal collectivist values and autonomous goal-striving. Furthermore, consistent negative associations were found between vertical individualist values and goal-autonomy, rather than the positive associations that some theorists



might expect. This suggests that it is important not to equate reflective autonomy or self-concordance with reactive autonomy or independence-seeking (Koestner & Losier, 1996; Ryan & Deci, 2000). Nor should one equate reflective autonomy with western individualism, nor view reflective autonomy as a quality opposed to collectivism.

Study 1 also found positive associations between goal-autonomy and both horizontal individualism and independent self-construal, but found no association between goal-autonomy and either vertical collectivism or interdependent self-construal. Taken together, then, the associations between goal-autonomy and the cultural style variables suggest that autonomous goal-strivers pursue an egalitarian ideal, thinking of themselves as distinct selves within a network of equal selves, rather than as interchangeable members of a collective self. Again, it was apparent that autonomous strivers are not necessarily more competitive or insensitive, as is sometimes assumed, but instead tend to be more open and accommodating towards others.

In addition, Study 1 replicated past findings of a positive association between goal-autonomy and SWB. Perhaps more importantly, Study 1 found that the positive association of goal-autonomy with SWB was not moderated by any of the four cultural value orientations identified by Triandis and Gelfand (1998), nor by independent or interdependent self-construals. In other words, people of every value orientation examined in this study benefited from goal-autonomy.

Study 2 adopted a somewhat different approach, by comparing members of an individualist and several collectivist cultures. We wished to examine both cultural mean differences in major study variables and cultural differences in patterns of associations between variables (i.e. moderator effects). To confirm our major hypotheses in these several different cultures would provide an important new type of support for our theoretical assumptions.

Analyses of mean differences revealed that Asian participants were much lower than U.S. participants in SWB, a finding that is consistent with earlier work (Diener et al., 1995;

Diener & Suh, 1999). However, there was no clear pattern of differences between Asian and U.S. participants for the goal-autonomy variable. This suggests that people can feel more or less autonomous everywhere, depending on other variables besides simple cultural membership.

More importantly, analyses of patterns of association revealed that goal-autonomy was predictive of at least one measure of SWB in every cultural sample. Also, in no case did goal-autonomy correlate negatively with SWB, as a strict cultural relativist perspective might predict based on the assumption that autonomous individuals do not "fit" within collectivist cultures.

Thus, these findings are consistent with our hypothesis that reflective autonomy is important in all cultures, and SDT's more general proposal that autonomy is a fundamental human need, whose satisfaction will tend to promote SWB for all individuals (Deci & Ryan, 2000). In other words, it appears that those who can attain a sense of self-initiation and self-ownership regarding their own personal initiatives benefit considerably. Indeed, this conclusion is consistent with humanistic, existential, organismic, cognitive-systemic, psychosocial, and psychodynamic perspectives upon optimal human functioning (Ryff & Singer, 1998; Sheldon et al., in press). This conclusion is also consistent with the standard evolutionary perspective, according to which the individual must be favored as the stronger source of his/her own behavior than the groups or cultures which contain the individual, for the simple reason that individuals are closer to their own genes (the unit of selection) than are groups and cultures (Dawkins, 1977; Sedikides, 2000).

#### Limitations and Future Research

Limitations of these studies include the fact that only college student samples were employed, and the fact that only self-report data were collected. Obviously, it will be important to replicate the findings using older adults, as college students may represent the most "westernized" segment of many traditional cultures. It will also be important to perhaps

eliminate method variance confounds by soliciting observer as well as self-reports regarding participants' apparent autonomy and/or SWB.

Future cross-cultural research should also examine within-participant variations in goals and SWB, in addition to the between-participants or cross-sectional differences studied herein. Such longitudinal studies would enable comparisons of patterns of dynamic fluctuations between goals and SWB across cultures, while helping to control for non-relevant between-culture differences. Future research should also study goal-autonomy, values and SWB in other cultures besides the U.S. and Asian cultures, as there are many other different types and styles of collectivism and of individualism. Finally, future research should directly address the important distinction between reactive and reflective autonomy, and their manifestation within different types of cultures. Perhaps there are lower rates of reactive autonomy in collectivist compared to individualist cultures, which may be the basis for the common assumption that autonomy is less prevalent within collectivist cultures.

In conclusion, the results of this study suggest a need for greater differentiation and phenomenological specificity in characterizations of autonomy, individualism and collectivism. It appears that being autonomous is not the same thing as being selfish, unduly self-enhancing, or hyper-competitive. In other words, there are positive forms of individualism, and we urge that cultural theorists not "throw out the baby with the bathwater" in a spate of revisionist zeal. In particular, our results support a view in which humans function more optimally and have more positive experiences when they are autonomously self-regulating, no matter what cultural values they might espouse. We hope that the current data have been at least somewhat persuasive regarding this proposition.

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Table 1

Study 1: Descriptive statistics

<u>Sample 1</u>		
<u>Variables</u>	Mean	Standard Deviation
Goal-Autonomy	3.66	2.23
Horizontal Collectivism	3.92	.54
Vertical Individualism	2.92	.81
<u>Sample 2</u>		
<u>Variables</u>	Mean	Standard Deviation
Goal-Autonomy	2.99	2.27
Horizontal Collectivism	3.74	.51
Vertical Individualism	2.96	.70
Horizontal Individualism	3.84	.60
Vertical Collectivism	3.62	.63
Independent Self-Construal	3.49	.46
Interdependent Self-Construal	3.37	.44

Table 2

Study 1: Relations of goal-autonomy with culturally-relevant constructs and with well-being

<u>Sample 1</u>			
	Horizontal	Vertical	Aggregate
	Collectivism	Individualism	SWB
Goal-Autonomy	.13 *	- .14 *	.23 **

<u>Sample 2</u>			
	Horizontal	Vertical	
	Collectivism	Individualism	Individualism
			Collectivism
Goal-Autonomy	.35 **	- .17 *	.19 *
			.11
	Independent	Interdependent	Aggregate
	Self-Construal	Self-Construal	SWB
Goal-Autonomy	.24 **	- .02	.25 **

Note. \*\*  $p < .01$  \*  $p < .05$

Table 3

Study 2: Descriptive statistics for the five samples

<u>Variables</u>	<u>Sample</u>				
	U.S.	S. Korea	Turkey	Taiwan	China
Goal-Autonomy	3.57	3.43	4.25	2.39 **	1.70 **
Aggregate SWB	4.73	3.16 **	4.17 **	2.78 **	3.41 **
Positive Affect	3.49	2.99 **	3.48	2.90 **	3.29
Negative Affect	2.10	2.56 **	2.40 **	2.56 **	2.64 **
Life-Satisfaction	3.34	2.73 **	3.09 *	2.44 **	2.77 **

Note. Significance tests compare each cultural mean to the mean for the U.S. sample.

Note. \*  $p < .05$ , \*\*  $p < .01$

Table 4

Study 2: Correlations of Goal-Autonomy and Nation-Level Variables with SWB Measures, for the Full Sample of 628

<u>Predictors</u>	<u>SWB Measures</u>			
	Positive Affect	Negative Affect	Life-Satisfaction	Aggregate SWB
Goal-Autonomy	.21 **	- .32 **	.20 **	.33 **
National Purchasing Power	.23	- .27	.27	.34
National Civil Rights	.17	- .25	.24	.29
Triandis Individualism Rating	.32	- .29	.35	.43

Note. \*  $p < .05$ , \*\*  $p < .01$

Table 5

Study 2: Correlations of Goal-Autonomy with SWB Measures, Separately by Culture

<u>Culture</u>	<u>SWB Measures</u>			
	Positive Affect	Negative Affect	Life-Satisfaction	Aggregate SWB
U.S.	.26 **	- .42 **	.12	.33 **
South Korea	.14 *	- .20 **	.22 **	.27 **
Turkey	-.01	-.25 *	-.01	.09
Taiwan	.19 *	-.35 **	.21 **	.40 **
China	.24	-.30 *	.05	.33 *

Note. \*  $p < .05$ , \*\*  $p < .01$



## Footnotes

<sup>1</sup> This was done in order to satisfy the requirements of a different study examining the relationship between "what" people strive for and "why" they strive for it (Carver & Baird, 1998; Ryan, Sheldon, Kasser, & Deci, 1996). Because these are all common categories in which people strive (Sheldon & Kasser, 1995), we do not believe that including this extra instruction appreciably affected the current results.

<sup>2</sup> Diener et al. (1995) did not present data for Taiwan. To estimate national individualism, purchasing power, and civil rights for Taiwan, we took the average of the values for South Korea and Mainland China, as suggested by Harry Triandis (personal communication, February 19, 2002).

<sup>3</sup> Data from the South Korean sample were used earlier to examine a different set of research questions (Sheldon et al., 2001).

<sup>4</sup> 161 Chinese participants completed questionnaires. Unfortunately, we were able to match up SWB and goal-data for only 41 of these respondents, because of an error of questionnaire administration. Providing some assurance that this sub-sample was equivalent to the main sample, we found no differences between the 41 final participants and the 120 excluded participants on any of the four SWB measures (all  $p$ s > .50). Thus we decided to include the Chinese data in this article.

<sup>5</sup> One way to test the significance of effects with this kind of data is to use the sample of cultures as the unit of analysis. However when the correlations are tested at the culture level none are significant, because of the extremely small  $n$  of five. Although multi-level modeling might be used to better estimate the significance of these effects, we have not done so herein because this issue is peripheral to our primary purposes.

Emotional and Cognitive Consequences of Adult Attachment:

The Mediating Effect of the Self

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Running Head: Adult Attachment and the Self

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## Abstract

It was hypothesized that adult attachment would influence emotional intelligence and cognitive organization through the quality of the self. Thus, the mediating effect of the true self in the relationship between attachment and both emotional and cognitive consequences was tested. The results showed that the secure attachment orientation was mediated by the true self to account positively for emotional intelligence and negatively for fragmented cognitive concepts, whereas the avoidant and anxious-ambivalent attachment orientations were mediated by lack of the true self to account negatively for emotional intelligence and positively for fragmented cognitive concepts. Discussion focuses on the role of the self in the consequences of attachment process.

## Emotional and Cognitive Consequences of Adult Attachment: The Mediating Effect of the Self

Attachment theory (Bowlby, 1969/1982, 1973, 1980) posits that the quality of interactions between infants and caregivers results in a set of expectations or "internal working models" that reflect an individual's appraisals and expectations of the relative safety or danger of a situation and an attachment figure's availability and responsiveness. Through interactions with persons and objects, the child constructs increasingly complex internal working models of the self and significant others. These interactions are contended to result in unique attachment orientations: secure, avoidant, and anxious-ambivalent (e.g., Ainsworth, Blehar, Waters, & Wall, 1978; Hazan & Shaver, 1987), and unique patterns of emotions and cognitions.

Research has supported the significant association between attachment and its emotional and cognitive consequences. However, few research has provided evidence on the relations between attachment and newly developed emotional and cognitive well-being indicators: emotional intelligence (Salovey & Mayer, 1990) and cognitive fragmentation (Donahue, Robins, Roberts, & John, 1993). In addition, few research has presented clear mechanisms of the quality of internal working model or the quality of the self in adulthood. Thus, the present study aimed (a) to examine the relations between adult attachment and emotional intelligence and cognitive fragmentation and (b) to clarify the role of the quality of the self and to examine the hypothesis that the true self mediates the links between adult attachment and emotional/cognitive consequences.

### Adult Attachment and Emotional Intelligence as Emotional Consequences

Adult attachment orientations have been influential in affect regulation. For example, secure attachment orientation has been associated with trust as well as flexible and appropriate adjustment to emotional experiences by acknowledging distress and tolerating stressful events without being overwhelmed by negative emotions (Collins & Read, 1990; Cooper, Shaver, & Collins, 1998; Mikulincer, Florian, & Weller, 1993; Simpson, Rholes, & Nelligan, 1992).

The avoidant orientation involves emotional distance from others (Hazan & Shaver, 1987; Mikulincer & Nachshon, 1991; Simpson et al., 1992; Simpson, Rholes, & Phillips, 1996) and distancing themselves from direct or symbolic confrontation with distress (Hazan & Shaver, 1987; Mikulincer, Florian, & Tolmatz, 1990; Mikulincer et al., 1993; Mikulincer, Orbach, & Iavnieli, 1998). The anxious-ambivalent orientation involves emotional volatility in social interaction (Simpson, 1990; Tidwell, Reis, & Shaver, 1996), high self-reported emotional expressiveness (Hazan & Shaver, 1990), hyper-vigilance regarding the distress source (Mikulincer & Florian, 1995; Mikulincer et al., 1998), rumination about negative experiences (Mikulincer & Orbach, 1995), and feeling of overwhelmed by negative emotions (Mikulincer et al., 1993).

Salovey and Mayer (1990) proposed that individual differences in emotional intelligence reflect an individual's distinct pattern of emotional regulation. Individuals differ in the "ability to monitor one's own and others' emotions to discriminate among them, and to use the information to guide one's thinking and actions" (Salovey & Mayer, 1990, p. 189). The scope of emotional intelligence includes multiple aspects of emotional regulation such as appraisal, expression, and utilization of emotion (Salovey, Hsee, &

Mayer, 1993). Emotional intelligence may be a good indicator of the degree in which individuals filter and utilize emotional experiences.

Salovey and colleagues (1995) found that individuals high in emotional intelligence reported lower level of depression and were able to repair their moods more quickly and effectively following failure and other disturbing experiences. Emotional intelligence has been associated with good psychological health (Mayer & Stevens, 1994), personality traits such as empathy, emotional control, low anxiety and neuroticism (Davies, Stankov, & Roberts, 1998; Kim, 1998), adequate emotional problem solving (Mayer & Geher, 1996), and negatively associated with difficulty in describing feelings (Davies et al., 1998).

The relation between emotional intelligence and attachment has received little attention, even though both processes concern emotion regulation. Based on the findings reviewed earlier, I expected that secure attachment orientation would be positively associated with emotional intelligence. In contrast, both avoidant attachment's denial pattern of emotion regulation and anxious-ambivalent attachment's hypervigilant emotional regulation were expected to be associated with lack of emotional intelligence.

#### Adult Attachment Cognitive Fragmentation as Cognitive Consequences

Adult attachment orientations also guide cognitive representations of self and others and interpretation of relationship-relevant events (Baldwin, 1992). Attachment working models affect the encoding and organization of information, and the self (Collins & Read, 1994; Mikulincer, 1995; Mikulincer & Orbach 1995). For example, secure individuals interpreted events in ways that minimized their negative impact and limited their importance for broader issues of relationship stability (Collins, 1996) and were more likely to rely on new information in making social judgments, while insecure individuals

preferred cognitive closure, relying on stable stereotypes to new information (Mikulincer, 1997).

Avoidant individuals were more likely to believe that their partners' negative behavior was caused by something the partner could have controlled (Collins, 1996), preferred information search to social interaction (Mikulincer, 1997), underestimated self-other similarity (Mikulincer et al., 1998), and projected their unwanted self-traits to others (Mikulincer & Horesh, 1999). Anxious-ambivalent individuals used the most negative explanations, viewing their partner as unresponsive and untrustworthy, and viewing their relationship as in conflict (Collins, 1996), overestimated self-other similarity (Mikulincer et al., 1998), and projected their actual self-traits to others (Mikulincer & Horesh, 1999).

Researchers have argued that cognitive structures for the self and others should be differentiated into multiple aspects that reflect varied social roles through the individual's unique relationships and social interactions (Mikulincer, 1995; Roberts & Donahue, 1994). When the various aspects of an individual's self-concept lack integration or are rigid and inflexible, the individual's cognitive self-concepts are considered to be fragmented (e.g., Gergen, 1971), which has been associated with depression and emotional distress (Donahue et al., 1993; Roberts & Donahue, 1994; Sheldon, Ryan, Rawsthorne, & Ilardi, 1997). Indeed, differences in attachment orientations have been uniquely associated with cognitive fragmentation. For example, individuals high in secure attachment orientation use various distinctive aspects to organize information about the self (i.e., differentiation) as well as have harmonious connections among differentiated self-aspects (i.e., integration) (Donahue et al., 1993; Linville, 1985; Mikulincer, 1995). In contrast, individuals high in

avoidant attachment orientation have a differentiated but less integrated self-structure, and anxious-ambivalent people have a less differentiated self-structure (Mikulincer, 1995).

This fragmented self concept has been applied to the romantic relationship domain, which is attachment-relevant, and was developed a measure to access the degree to which individuals cognitive concepts on their romantic relationships integrated or fragmented across roles in relationship (Kim, 2001). For an example of fragmented relationship-concepts, one woman might see her boyfriend as caring and honest as a friend, but as possessive and uncertain as a romantic partner. In contrast, another woman might see her boyfriend as caring and honest as both a friend and romantic partner. The former woman has a more differentiated relationship-concept, and if the concept lacks coherence among various relationship roles, it can be considered fragmented.

Related to attachment orientation in the present study, I expected that secure attachment orientation would be inversely associated with fragmented self- and relationship-concepts, whereas insecure attachment orientations (viz., avoidant and anxious-ambivalent) would be positively associated with fragmented self- and relationship-concepts.

In summary, it appears that the contention that insecure attachment is negatively associated with emotional and cognitive well-being receives robust empirical support. However, few study has examined the association with emotional intelligence and cognitive fragmentation. In addition, specific mechanisms through which the internal working models operate on cognitive and emotional well-being remain unclear (Mikulincer, 1995). The present study proposes a motivational structure of the self as the



link between attachment orientation and both emotional intelligence and cognitive organization.

### Adult Attachment and the Self

Attachment theory contends that internal working models serve to filter interpretation of relationship-relevant events and thereby shape an individual's view of his or her social world. This contention has been widely supported (for review, see Shaver, Collins, & Clark, 1996). For example, individuals with secure attachment orientation report self-confidence and positive self-concepts (Brennan & Morris, 1997; Cooper et al., 1998) and being better-liked by others compared to avoidant and anxious-ambivalent people (Hazan & Shaver, 1987; Shaver & Hazan, 1993). Contrary, individuals with avoidant attachment orientation viewed themselves as less confident in social situations and as less interpersonally oriented than secure individuals (Bylsma, Cozzarelli, & Sumer, 1997; Collins & Read, 1990) and were compulsively self-reliance and defensive (Mikulincer, 1998; Mikulincer et al., 1998). Anxious-ambivalent attachment orientation has been associated with the belief that others are complex and difficult to understand and that people have little control over the outcomes in their lives (Collins, 1996; Collins & Read, 1990; Hazan & Shaver, 1987) and with the hypervigilant attention to distress that inhibits the development of autonomy and self-confidence (Cooper et al., 1998).

Recently, two dimensions of attachment have been conceptually suggested (Bartholomew & Shaver, 1998) and empirically validated (Brennan, Clark, & Shaver, 1998). The secure-avoidant dimension shares a similarity of self-reliance, intimacy, and closeness, while these features are different in ways that it is a reflection of balanced and coherent self-structure for secure individuals (Mikulincer, 1995, 1998) and it is a mask to

distance from the self and others for avoidant individuals (Kotler, Buzwell, Romeo, & Bowland, 1994; Mikulincer et al., 1993). The anxiety dimension is characterized as preoccupation with attachment, jealousy, and fear of rejection (Brennan et al., 1998), which is a reflection of pawn-like self in the relation to other. This dimensional approach also suggests a closer look at the different underlying quality of the self in adulthood.

The self-determination theory (Deci & Ryan, 1985, 1991) appears to provide relevant theoretical framework for understanding the quality of the self. Deci and Ryan (1991) proposed that the self develops in the context of the fit between the individual's psychological needs and environmental supports. When the individual's psychological needs and environmental support are optimally matched, individuals are more likely to develop the true self, which refers to a set of motivational processes representing intrinsic growth tendencies toward integration of one's own experience and behavior with one's sense of relatedness to others, not simply reflecting social forces. The true self is hypothesized to be associated with the experience of choice in behaviors, lively energy in daily life, and sense of genuine self contact. In contrast, a developing sense of self that evolves in a non-supportive environment may lead to a non-true or "heteronomous" self, or one with a defensively avoidant or pawn-like stance (Bretherton, 1987; Deci & Ryan, 1991; Feeney & Noller, 1990; Mikulincer, 1995; Ryan, 1995), which may result in lack of genuineness and satisfaction. The true self is conceptualized as organismically optimal form of working models of attachment, which is a close precursor of individuals' emotional and cognitive well-being.

Specifically, self-determination theory posits that secure attachment may be related to a true self through optimal fit between innate organismic relatedness needs and

important others availability (Deci & Ryan, 1991; Ryan & Lynch, 1989). Conversely, through adult interpersonal relationships that are inconsistent, contingent, or unavailable to meet organismic needs (Collins & Read, 1990; Deci & Ryan, 1991; Feeney & Noller, 1990), the self of anxious attachment individuals may be heteronomous, resulting in conditional self-worth. These qualitative differences are proposed to create different emotional and cognitive consequences.

Recent studies have supported this compelling effect of the mediator, the self, in the link between adult attachment and depressive symptoms (Roberts, Gotlib, & Kassel, 1996) and problem solvings in interpersonal situations (Davila, Hammen, Burge, & Daley, 1996), in ways that insecure attachment was associated with low self-esteem (Collins & Read, 1990; Feeney & Noller, 1990; Roberts et al., 1996), which leads to increases in depression (Roberts et al., 1996) and poor interpersonal problem solving (Davila et al., 1996). The “if-then” self worth of insecure attachment (e.g., “I’m nothing if a person I care about doesn’t love me”: recited from Roberts et al., 1996) is, however, a heteronomous self rather than a genuine true self. Few studies has examined the role of the true self, compared to global self-esteem, in the link between attachment and emotional and cognitive consequences. The present study will thus attempt to answer this compelling question on the mediating role of the true self in those associations.

Based on previous findings and theoretical grounds, compared to an insecure model's poor emotional regulation and cognitive fragmentation, a secure internal working model of the self and others is hypothesized to set the stage for healthy patterns of emotional regulation, attentiveness to feelings and clarity about them, a capacity to recover from negative emotions, and better integration of self- and relationship-concepts. In

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- addition, a true self which is hypothesized to be formed via a secure internal working model may mediate the links between attachment and emotional and cognitive consequences (see Figure 1). More specifically, secure relative to avoidant attachment dimension, defined by comfort with closeness and interdependence, was predicted to be positively associated with the true self, in turn leading to higher levels of emotional intelligence and cognitive integration. Anxious attachment dimension, defined by heightened desire for intimacy along with insecurity about others' response, was predicted to be negatively associated with the true self, leading to lower emotional intelligence and to more cognitive fragmentation.

## Method

### Participants and Procedure

One hundred eighteen college students (50 men, 68 women) participated in the study. They received partial course credit for their participation. They were asked to fill out questionnaires in small groups of up to 20. The questionnaire consisted of measures of attachment orientation, true self, emotional intelligence, and fragmented self- and romantic relationship-concepts, with instructions for self-administration. Participants were debriefed following participation. Among participants, 40 % were currently involved in a romantic relationship, 33 % were not, and 27% did not indicate. The mean relationship length was 21.46 months ( $SD = 55.73$ ).

### Measures

I used the following manifest variables to derive the latent variables depicted in Figure 1.

Attachment Orientation Dimensions. Hazan and Shaver's (1987) prototypical descriptions of feelings and cognitions regarding three attachment orientations were captured by a 15-item scale including five statements that describe each three prototypic attachment pattern (e.g., Simpson, 1990). Participants were asked to rate the personal applicability of all fifteen statements on a 7-point Likert scale (1 = not at all like me, 7 = very much like me). Sample items tapping secure attachment includes "I am comfortable depending on others" ( $\alpha = .55$  in the current data set); for avoidant attachment, "I find it difficult to trust others completely" ( $\alpha = .72$ ); and for anxious-ambivalent attachment, "I often worry that my partner doesn't love me" ( $\alpha = .75$ ). Secure and avoidant attachments were indicators of secure-avoidance attachment dimension, while two parcels (two or three items per parcel) created with the five anxious-ambivalent attachment items were indicators of anxious attachment dimension in the present study.

True Self. The Self-Determination Scale (Sheldon & Deci, 1996) and the Vitality (Ryan & Frederick, 1997) were utilized to assess the individual's true self. The Self-Determination Scale is a ten-item scale which assesses a general sense of both self-contact and choicefulness. Each item presents two statements labeled A and B. One represents self-determined and the other represents non-self-determined. Participants use a 9-point bipolar scale indicating how true each statement is for them (1 = only A feels true; 5 = both feel equally true; 9 = only B feels true). For example, "I feel that I am rarely free to be myself" versus "I feel like I am always completely myself" is a self-contact item, and "What I do is often not what I'd choose to do" versus "I am free to do whatever I decide to do" is a choicefulness item. Self-contact and choicefulness scores were calculated by relevant five item scores after reverse-coding as necessary so that a higher score indicated

more self-contact ( $\alpha = .79$ ) and choicefulness ( $\alpha = .51$ ). Self-determination has been positively associated with generalized expectancies for negative mood regulation and life satisfaction, and negatively associated with depression and physical symptoms (Kim, 1998).

A seven-item Vitality Scale (Ryan & Frederick, 1997) assessed characteristics of experiencing aliveness and vigor (e.g., "I feel alive and vital"). Participants were asked to rate the applicability of all seven statements on a 7-point Likert scale (1 = not at all true, 7 = very true). The seven items were averaged after reverse coding as necessary ( $\alpha = .86$ ). Vitality has been positively associated with self-actualization and personality integration (Ryan & Frederick, 1997).

Global self-esteem was assessed in order to compare the role with that of true self in the proposed model in the study, by the widely used 10-item Rosenberg Self-Esteem Inventory (Rosenberg, 1965), which has been positively associated with authentic self (Sheldon et al., 1997). An example item is "On the whole, I am satisfied with myself." The ten items were averaged after reverse coding as necessary ( $\alpha = .79$ ).

Emotional Intelligence. The Trait Meta-Mood Scale (Salovey et al., 1995) measures the extent to which individuals differ in the ability both to identify feelings and to regulate these feelings in order to motivate adaptive social behaviors. The short version of the TMMS consists of 24 items to measure individual differences in attention to mood (Attention: e.g., "I am often aware of my feelings on a matter"; ( $\alpha = .85$ ), clarity in discriminating among feelings (Clarity: e.g., "I am usually very clear about my feelings"; ( $\alpha = .81$ ), and beliefs about maintaining positive moods and repairing negative moods (Repair: e.g., "Although I am sometimes sad, I have a mostly optimistic outlook"; ( $\alpha = .74$ )).

(Salovey et al., 1995). Participants responded to items along a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). Each item score is averaged within a relevant subscale after reverse coding as necessary; higher scores refer to more attention to and clarity about feelings, and repairing negative moods, respectively.

Fragmented Cognitive Concepts. *Fragmented Self-Concept (FSC)*: Participants rated themselves on 33 self traits (Linville, 1985) five times for each of five social roles: student, friend, romantic partner, son or daughter, and worker (Donahue et al., 1993), using an 8-point Likert scale (1 = "little like me", 8 = "extremely like me"). Each role was presented on a separate page, and participants were not permitted to refer back to prior ratings. The 33 attributes were presented in a different order for each role. To compute the FSC score, Donahue and colleagues proposed using factor analysis to assess the proportion of variance in the role-identity ratings not shared across roles, following procedures developed by Block (1961). For each participant, a factor analysis was conducted on the 5 roles X 33 self-attributes, then the percentage of the common variance was subtracted from 100. Higher percentages indicate more independence among self-attributes across roles and more fragmented self-concepts. *Fragmented Relationship-Concept (FRC)*: The same procedure was followed to rate roles and attributes of romantic relationships, using four romantic partner roles and 32 attributes of romantic relationships (e.g., warm, jealous, attractive) (Kim, 2001). Participants were asked to think about their current or past romantic partner, or a hypothetical partner if they have not had such a person, when they rate the attributes of romantic relationships within each role as a romantic partner. For both FSC and FRC measures, participants were asked to imagine as if they were in a certain role if they have not been a certain role. FSC and FRC could range from 0% to

100% and actual ranges were 42.7% to 74.4% ( $M = 60.78\%$ ,  $SD = 6.14$ ) for FSC and 41.7% to 71.2% for FRC ( $M = 57.16\%$ ,  $SD = 5.00$ ).

## Results

### Correlations Among Variables

As shown in Table 1, secure attachment was positively correlated with choicefulness, vitality, and emotional intelligence measures (viz., attention, clarity, and repair), but negatively correlated with avoidant attachment. Avoidant attachment was negatively correlated with self-contact and emotional intelligence measures. Anxious attachment parcels were positively correlated with fragmented self-concept and were negatively correlated with self-contact, clarity, and repair. Anxious attachment was not correlated with secure or avoidant attachment, which supports the dimensional view on attachment. Correlation coefficients between attachment dimension measures and emotional intelligence measures were significant except attention, but those between attachment and fragmented cognitive concept measures were relatively weak, possibly supporting the hypothesis regarding an indirect path between attachment and emotional and cognitive measures.

The true self measures were positively correlated with each other and were positively correlated with clarity and repair but not significantly correlated with attention among emotional intelligence measures. In addition, the true self measures were in general negatively associated with fragmented cognitive concepts. The emotional intelligence subscales tended to be negatively correlated with fragmented cognitive concepts but only correlation between repair and fragmented self-concept was significant. Finally,



fragmented self-concept (FSC) was positively correlated with fragmented relationship-concept (FRC).

### Structural Equation Model

The zero-order correlations showed preliminary links among attachment dimensions, true self, emotional intelligence, and fragmented cognitive concepts. However, the validity of assessing latent variables by certain observed variables and the effect of predicted mediator in target links remained unexamined. In order to explore these two inquiries, a structural equation model was tested, using LISREL 8 (Jöreskog & Sörbom, 1996).

Model Specification. First, the validity of assessing five latent variables in the present study utilizing sets of observed variables was examined. The model parameters were specified as follows: the observed variables for each relevant latent variable were specified not to have a zero loading on the relevant factor while the loadings on all other factors were constrained to equal zero. For example, choicefulness, self-contact, and vitality measures were specified not to have a zero loading on the true self latent factor while the loadings on all other latent factors (viz. attachment dimensions, emotional intelligence, and fragmented cognitive concepts) were constrained to equal zero. All off-diagonal elements in the measurement error matrices were fixed to zero, thus measurement error variances were not allowed to be correlated each other.

Second, in order to test the predicted mediating effect of the true self between attachment dimensions and both emotional intelligence and fragmented cognitive concepts, the structural component of the model was specified as follows: paths from exogenous variable (viz., attachment dimensions) to endogenous variables (viz., true self, emotional

intelligence, and fragmented cognitive concepts) were specified as free parameters to be estimated with current data. These paths will provide the information on direct impact from attachment to emotional intelligence and cognitive fragmentation. The paths from true self to emotional intelligence and from true self to fragmented cognitive concepts were also specified as free to be estimated. These paths will provide the information on mediating effect of true self in the links between attachment dimensions and emotional intelligence and cognitive fragmentation. All other paths were constrained to zero. All errors in equations for the endogenous variables were specified as free to be estimated. LISREL employs maximum likelihood (ML) methods to estimate free parameters (Jöreskog & Sörbom, 1996).

Evaluating Model Fit to the Data. The present study used three model fit indices: the Goodness of Fit Index (GFI; Tanaka & Huba, 1989), the Comparative Fit Index (CFI; Bentler, 1990), and the Incremental Fit Index (IFI; Bollen, 1989). For all three indices, values of .90 or greater reflect an adequate fit of a specified model to the data. The fit of the specified model was satisfactory,  $\chi^2(46, N = 118) = 70.46$ , GFI = .92, CFI = .90, and IFI = .91. All path coefficients reported in Figure 2 were completely standardized.

First, the validity of assessing latent variables was examined. As depicted in Figure 2, secure attachment loaded positively on the secure-avoidant attachment latent factor while avoidant attachment loaded negatively on the secure-avoidant attachment latent factor. Two parcels of anxious-ambivalent attachment orientations loaded positively on the anxiety attachment latent factor. Choicefulness, Self-contact, and Vitality loaded positively on the true self latent factor. Subscales of emotional intelligence and fragmented self- and relationship-concepts loaded positively on the emotional intelligence and

fragmented cognitive concept latent factors, respectively. Thus, each latent variable was assessed with appropriate manifest indicators.

The predicted mediating effect of the true self was examined next. Predicted paths from attachment dimensions to true self, from true self to emotional intelligence, and from true self to fragmented cognitive concepts were all significant,  $t_s > 2.00$ ,  $p_s < .05$  (see Figure 2). In contrast, direct paths from attachment dimensions to either emotional intelligence or fragmented cognitive concepts were not significant,  $0 < t_s < 1.82$ ,  $p_s > .05$ , indicating the impact of attachment on emotional and cognitive consequences is mediated by the true self.

When the global self-esteem latent factor was included as another mediator in order to compare with the role of true self in the proposed model, the model fit was still satisfactory,  $\chi^2(52, N = 118) = 72.74$ , GFI = .92, CFI = .92, and IFI = .93. In this model, paths from secure-avoidant attachment dimension to both true self and global self-esteem ( $\beta = .48, .32$ ,  $p_s < .01, .05$ , respectively), the path from anxious attachment dimension to true self ( $\beta = -.27$ ,  $p < .05$ ), and the path from true self to emotional intelligence ( $\beta = .56$ ,  $p < .05$ ), were significant. However, paths from anxious attachment dimension to global self-esteem and paths from global self-esteem to either emotional intelligence or cognitive fragmentation were not significant. Direct paths from attachment dimensions to emotional intelligence or cognitive fragmentation were also not significant. Thus, the true self, independent of global self-esteem, remained to mediate the relation between attachment dimensions to emotional intelligence.

Supplementary Analyses. Because these results were based on correlational data from a cross-sectional assessment, other models might also fit the data reasonably well. To

examine this possibility, a couple of alternative models were considered. For one, it might be argued that the true self is a cause, not a consequence of attachment. Thus, attachment might mediate in the link between the true self and both emotional intelligence and fragmented cognitive concepts. Goodness-of-fit indices suggested that the fit of this alternative model,  $\chi^2(46, N = 118) = 70.25$ , GFI = .92, CFI = .90, and IFI = .91, was comparable to the true self-mediation model. Paths from true self to secure-avoidant attachment dimension ( $\beta = .40, p < .05$ ), to anxiety attachment dimension ( $\beta = -.27, p < .10$ ), to emotional intelligence ( $\beta = .69, p < .05$ ), and to fragmented cognitive concepts ( $\beta = -.44, p < .05$ ) were all significant or marginally significant, whereas paths from secure-avoidant attachment dimension to emotional intelligence ( $\beta = .37, p < .10$ ) and fragmented cognitive concepts ( $\beta = -.01, p > .10$ ); from anxiety attachment dimension to emotional intelligence ( $\beta = -.01, p > .10$ ) and to fragmented cognitive concept ( $\beta = .21, p > .10$ ), was marginally significant or were not significant. Although this alternative model turned out as a good fit model, the direct paths from the true self to emotional and cognitive consequences were stronger than indirect paths through attachment. In other words, attachment did not mediate the link between the true self and both emotional intelligence and fragmented cognitive concepts.

It also might be argued that both the self and attachment are equally influential on emotional and cognitive well-being. Thus, a model with both self and attachment as exogenous variables and both emotional intelligence and fragmented cognitive concept as endogenous variables was examined. This parallel model fit was less satisfactory,  $\chi^2(48, N = 118) = 81.97$ , GFI = .90, CFI = .86, IFI = .87. Only significant were the paths from secure-avoidant attachment dimension to emotional intelligence ( $\beta = .46, p < .05$ ), from

• true self to emotional intelligence ( $\beta = .77, p < .05$ ), and from true self to fragmented cognitive concept ( $\beta = -.57, p < .05$ ). Thus, the more critical predictor of emotional and cognitive consequences seems to be the true self in the attachment internal working model, rather than attachment *per se*.

## Discussion

The main purposes of the present study were to examine the role of adult attachment dimensions in emotional intelligence and cognitive fragmentation and to investigate the hypothesis of true self mediating in these relations. The present study deals with conceptually important questions on the role of the self and emotional regulation in adult attachment, and examined the mechanisms that underlie internal working models of attachment. The findings were consistent with the view that the true self might mediate between attachment and both emotional intelligence and integrated cognitive concepts. These results are consistent with the contention of attachment theory that internal working models of the self influence emotional and cognitive outcomes (e.g., Collins & Read, 1994; Shaver et al., 1996).

Adult attachment dimensions were associated with the quality of self, emotional intelligence, and cognitive fragmentation. Individuals, who reported believing that others were available when needed, feeling comfortable becoming close to others, and less worrying about abandonment and not being loved, tended to have true self, to be able to clearly attend to emotions and recover negative mood, and to have lower level of cognitive fragmentation. The present study was the first of which I am aware that systematically examines the relation between attachment and either emotional intelligence or fragmented cognitive concepts.

In previous studies, emotional intelligence and fragmented cognitive concepts have been demonstrated their association with psychological/physical well-being indicators. For example, as a part of social intelligence (Gardner, 1993) or practical intelligence (Sternberg, Wagner, Williams, & Horvath, 1995), abilities to evaluate and regulate emotions as well as to understand the feelings of others have demonstrated impact on personal well-being (Salovey et al., 1995) and social functioning (Mayer & Geher, 1996). Fragmented cognitive concepts also have been linked to dissatisfaction with marriage and work (Roberts & Donahue, 1994), depression, perceived stress, and physical symptoms (Sheldon et al., 1997). In the present study, secure-avoidant attachment dimension was related more strongly to emotional intelligence, while anxious attachment dimension was related more strongly to fragmented cognitive concepts. It suggests that the two dimensions of working models of attachment may have unique contributions to emotion regulation and cognitive structures. Thus, different dimensions of attachment may be associated with psychological disorder or physical illnesses in different degrees.

Most importantly, the findings in the present study indicate that the relations between adult attachment and emotional intelligence and fragmented cognitive concepts were mediated by authentic self-worth. Compared with the nonsignificant role of global self-esteem in the links between attachment dimensions and both emotional intelligence and fragmented cognitive concepts, the true self significantly mediated the link between secure-avoidant attachment dimension and emotional intelligence. These findings indicate that both avoidant and anxious-ambivalent attachment orientations are associated with the heteronomous self model, whereas secure attachment orientation was associated with the true self model. This distinct quality of the self model may provide the underlying

mechanism of insecure individuals' inadequacy in social situations (Collins & Read, 1990; Davila et al., 1996; Roberts et al., 1996). That is, insecure people's heteronomous self, developed through unmet relatedness needs in controlled social contexts, may result in inadequate emotional regulation and cognitive organization, which would appear in certain social situations.

The present study suggests that the root of both emotional intelligence and cognitive organization may lie in interpersonal relationship experiences and the manner in which the development of the self is supported in social contexts. In other words, the finding suggests that the nature of true self may lie in the degree in which individuals develop genuine self-worth grounded on vigor and choiceful self-contact, clarifying the characteristic of internal working model. This quality of self, rather than apparent global self-esteem, may be a precise mechanism of attachment working models in emotional regulation and cognitive structure. The role of the true self in working models of attachment needs to be further examined with other well-being indicators. For example, autonomous reasons of withholding expression of negative affect buffered the stress effect on physical symptom reports (Kim & Deci, 2001). Chronic experiences of distress and anxiety in interpersonal relationships may lead physical illnesses through a dysfunctional heteronomous self. In addition, individuals who feel insecurely attached but maintain a healthy sense of self-worth may regulate emotions and integrate cognitions well, regardless of their attachment security.

Model fit statistics for both self mediation model and attachment mediation model were equally good. However, the attachment mediation model showed weak connections from attachment to both emotional intelligence and fragmented cognitive concepts,

whereas the self mediation model showed significant connections from the self to both outcome variables. The self mediation model is theoretically more compelling than the attachment mediation model because of its proposed developmental sequence: that the internal working model of the self develops from interactions with attachment figures. It was also a better empirical fit in the present data. Early childhood attachment experiences have been assumed to impact attachment, self-esteem, and general adjustment in adulthood (Bowlby, 1988; Bretherton, 1987; Main, Kaplan, & Cassidy, 1985; Rothbard & Shaver, 1994). However, continuity of attachment (in)security across the life span should be conceptualized as a combination of the internalization of early relationship experiences and confirmation of the internalized working models in current relationships (Roberts et al., 1996). Thus, the developmental speculation on the relation among attachment dimensions, the true self, and emotional, cognitive consequences should have special caveat with current cross-sectional data. Longitudinal studies are needed to verify the causal links suggested by this study.

In addition, emotional intelligence measures were highly correlated with true self measures in the present study, thus it could be hard to justify the path from the true self to emotional intelligence. Conceptually, the true self in the present study involves a feeling of choicefulness and self-contact in behaviors, emotions, and cognitions and a feeling of aliveness and vigor, thus implies an intelligent form of general self-regulation including emotional intelligence, whereas emotional intelligence involves clear awareness of and ability to regulate emotion, more specifically. Thus, in the present study model, I hypothesized the global sense of self-regulation measured by the true self components would impact on specific emotional regulation. However, I acknowledge that it could go



the other way. Again, a longitudinal design is necessary to validate the conceptual causal link in future studies.

It will be also important for future research to include the four-category attachment orientation measure developed by Bartholomew and Horowitz (1991), which distinguishes fearful and dismissing avoidant orientations. Indeed, fearful avoidant attachment orientation is characterized by low feelings of self-worth and negative expectations about the availability and responsiveness of significant others, while dismissing avoidant attachment orientation is characterized by strong emphasis on self-reliance and negative concept on others (Fraley & Shaver, 1997). Although both forms of avoidant attachment involve the conscious desire to avoid intimate interpersonal relationships, fearful attachment involves a fear of the possible consequences of being close to others and dismissing attachment involves a disregard for interpersonal closeness (Bartholomew & Horowitz, 1991; Fraley & Shaver, 1997). Dismissing adults have reported higher levels of global self-esteem and competence than fearful adults (Blyssma et al., 1997; Brennan & Morris, 1997), and fearful attachment has been associated with nonclinical depression (Carnelly, Pietromonaco, & Jaffe, 1994).

As the present mediational model was tested with a college sample, it is an open question whether such findings generalize to other samples. Limitations notwithstanding, the present study demonstrates the importance of internal working models to understanding people's emotional functioning and cognitive organization. The present work provides insight into the mechanisms that may underlie attachment style differences in emotional intelligence and fragmented cognitions. The present model is useful for clarifying

processes and for developing a theoretical mediational model through which internal working models of attachment relate to emotional and cognitive well-being.

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Table 1. Correlation Matrix of Variables

	1	2	3	4	5	6	7	8	9	10	11	12
1. Secure	1.01											
2. Avoidant	-.44***	1.16										
3. Anxiety_1	-.12	.04	1.30									
4. Anxiety_2	-.08	.04	.68***	1.59								
5. Choice	.17*	-.11	-.09	-.14	1.50							
6. Self-contact	.16	-.24**	-.16	-.20*	.45***	1.22						
7. Vitality	.16	-.09	-.03	-.14	.21*	.23**	1.13					
8. Attention	.19*	-.39***	.11	.09	.03	.06	.07	.52				
9. Clarity	.25**	-.28***	-.22*	-.17*	.36***	.37***	.27***	.14	.58			
10.Repair	.26**	-.28***	-.23**	-.22**	.31***	.23**	.50***	.29***	.44***	.59		
11.FSC	-.07	.07	.10	.24**	-.18*	-.15	-.21*	.05	-.15	-.17*	6.45	
12.FRC	-.05	.13	-.02	.01	-.27**	-.03	-.08	-.02	-.10	-.16	.19*	5.00

\* p < .05      \*\* p < .01      \*\*\* p < .001

Numbers in diagonal are SDs

Note: Secure = secure attachment orientation; Avoidant = avoidant attachment orientation;

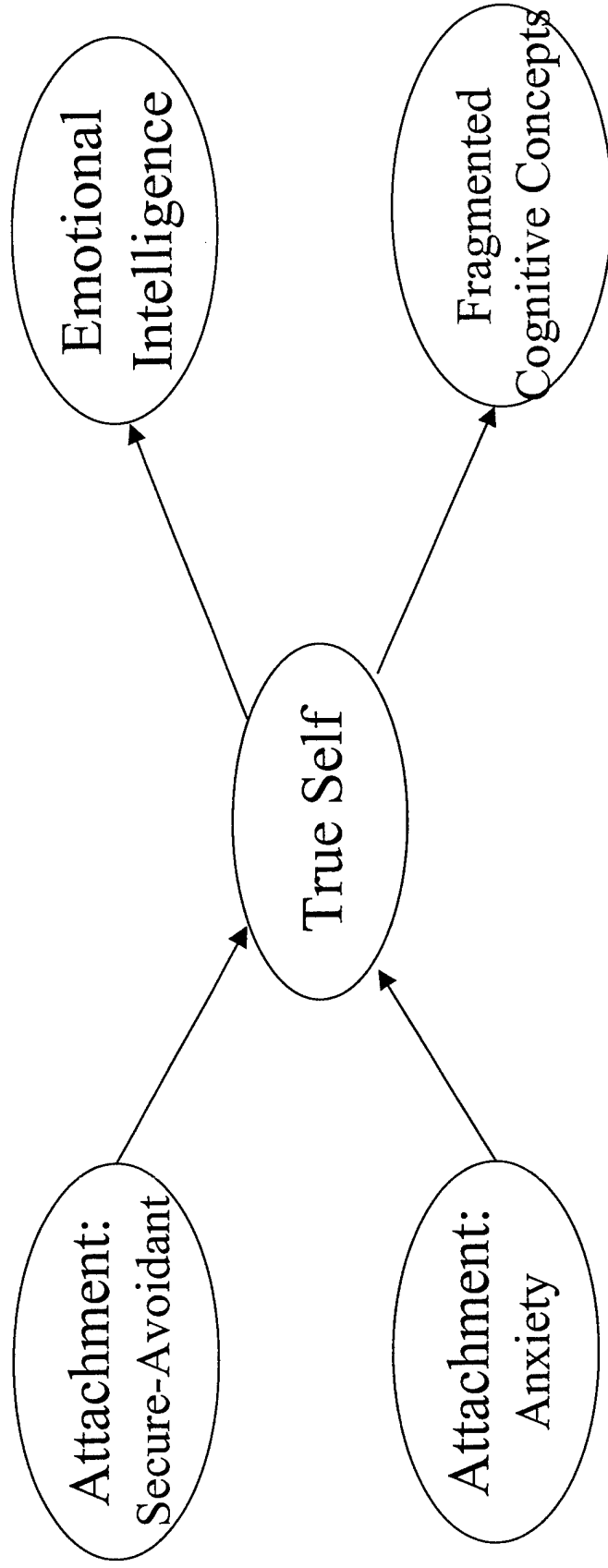
Anxiety\_1, aAnxiety\_2 = anxious-ambivalent attachment parcels;

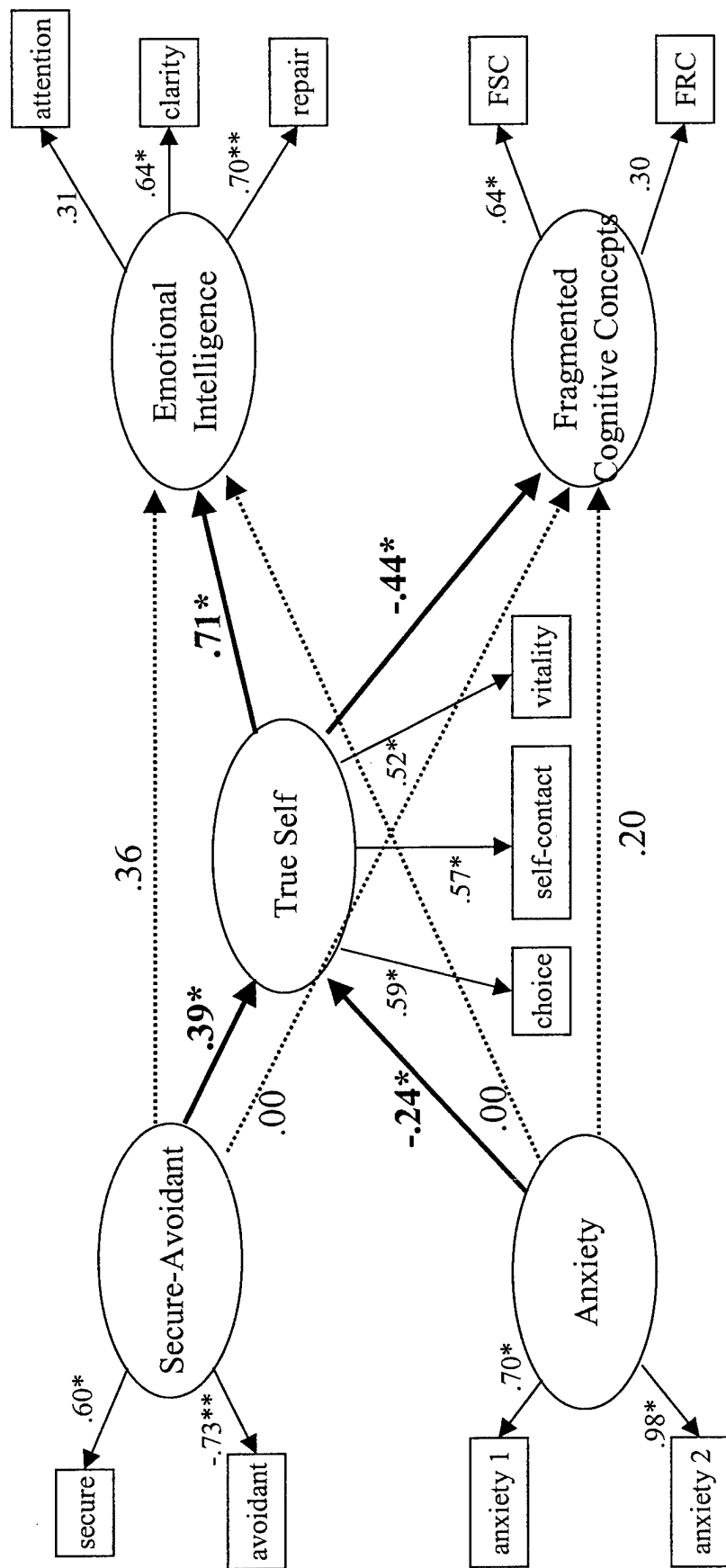
FSC = fragmented self-concept; FRC = fragmented relationship-concept.

### Figure Labels

Figure 1. The conceptual model: The mediating effect of the self in the relation between attachment and emotional/cognitive consequences

Figure 2. The statistical model: The mediating effect of the true self in the relation between attachment and emotional intelligence and fragmented cognitive concepts





Note: FSC = Fragmented Self Concept; FRC = Fragmented Relationship Concept